

RCRA FACILITY INVESTIGATION LOCKWOOD CORPORATION GERING, NEBRASKA

Final Approved Version

Prepared for

Lockwood Corporation

Gering, Nebraska 68341

~~Revised October 1991~~

Revised February 1992

HWS 
Technologies Inc.

RCRA



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LOCKWOOD October 1991

PHASE I

~~INITIAL~~ SCREENING/VERIFICATION

PHASE I

SECTION 1.0

ITEM V.B.1.b.

**CHARACTERIZATION PLAN FOR
INITIAL SOIL SCREENING/VERIFICATION PLAN**

1.1 Introduction

The purpose of this plan is to ~~verify and screen for the presence of~~ contaminants characterize the nature and extent of possible releases at the following Solid Waste Management Units (SWMU) at the Lockwood facility in Gering, Nebraska:

1. Hazardous Waste (drum) Storage Area;
2. Waste Oil Storage Area;
3. Waste disposal area east of Machine Shop;
4. Raw product storage area.
5. Other Stained or Discolored Areas.

~~It is Lockwood's intention that this initial Soil Screening/Verification Plan will adequately address all concerns as to whether contaminants found during the RFA exist at levels exceeding EPA proposed Action Levels for soils (as given in Table 1.0).~~

~~For those SWMU's where contaminants do not exceed EPA Maximum Contaminant Levels (MCL's) or proposed action levels, Lockwood proposes that no verifiable release of concern has occurred, and no further action will be necessary. For those SWMU's where EPA action levels are exceeded, Lockwood proposes to proceed with Phase II sampling (see Figures 1.1(a-b)).~~

The objective of this initial sampling effort (Phase I) is to begin defining the horizontal extent of contamination that may be associated with these SWMUs. The need for additional sampling in these areas to address vertical migration and surface water runoff will be based on the concentration of contaminants detected. These Phase I values will be compared to the proposed U.S. EPA action levels for

Corrective Actions under RCRA; or where no RCRA standard has been proposed, commonly used standards at CERCLA sites in Region VII will be considered (Table 1). For the SWMUs where EPA action levels are exceeded, Lockwood proposes to proceed with Phase II sampling (Section 5.0), which will begin the process of determining the vertical extent of contamination and continue defining the horizontal extent of contamination.

Table 1.0 has been replaced with the complete list of proposed Action Levels for RCRA Corrective Actions (only volatile and semi-volatile and select metals are relevant to this workplan. Detection limits should be comparable to U.S. EPA detection limits required under the Contract Laboratory Program (i.e., SW-846).

1.2 Site Soil Characteristics

Site surface soil characteristics on-site can be described as a silty clay/silty sand with 10-15% fine sand, dark brown, moist, and low plasticity to a depth of about 3 feet (see boring logs Appendix A and B). From depths of approximately 3-10 feet the soils are characterized by sand (fine to coarse, 5-15% fines, brown) or silty sand (30-45% fines, fine to coarse, brown).

TABLE 1

A-1

Appendix A: Examples of Concentrations Meeting Criteria for Action Levels
(Section 264.521(a)(2)(i-iv))

Constituent Name	Class	Air (ug/m ³)	Water (mg/L)	Soils (mg/kg)
Acetone	D	-	4E-00	8E+03
Acetonitrile	D	-	2E-01	5E+02
Acetophenone	D	2E-01	4E-00	8E+03
Acrylamide	B2	8E-04	8E-06	2E-01
Acrylonitrile	B1	1E-02	6E-05	1E-00
Aldicarb	D	-	5E-02	1E+02
Aldrin	B2	2E-04	2E-06	4E-02
Allyl alcohol	D	-	2E-01	4E+02
Aluminum phosphide	D	-	1E-02	3E+01
Aniline	B2	-	6E-03	1E+02
Antimony	D	-	1E-02	3E+01
Arsenic	A	7E-05	(1)	8E+01
Asbestos (2)	A	2E-02	-	-
Barium cyanide	D	-	2E-00	6E+03
Barium, ionic	D	4E-01	(1)	4E+03
Benzidine	A	2E-05	2E-07	3E-03
Beryllium	B2	4E-04	8E-06	2E-01
Bis(2-ethylhexyl)phthalate	B2	-	3E-03	5E+01
Bis(chloroethyl)ether	B2	3E-03	3E-05	6E-01
Bromodichloromethane (3)	B2	-	3E-05	5E-01
Bromoform (3)	D	-	7E-01	2E+03
Chloromethane	D	3E+01	5E-02	1E+02
1 benzyl phthalate	C	-	7E-00	2E+04
Cadmium	B1	6E-04	(1)	4E+01
Calcium cyanide	D	-	1E-00	3E+03
Carbon disulfide	D	-	4E-00	8E+03
Carbon tetrachloride	B2	3E-02	3E-04	5E-00
Chloral	D	-	7E-02	2E+02
Chlordane	B2	3E-03	3E-05	5E-01
Chlorine cyanide	D	-	2E-00	4E+03
Chlorobenzene	D	2E+01	7E-01	2E+03
Chloroform (3)	B2	4E-02	6E-03	1E+02
2-Chlorophenol	D	-	2E-01	4E+02
Chromium (VI)	A	9E-05	(1)	4E+02
Copper cyanide	D	-	2E-01	4E+02
m-Cresol	D	-	2E-00	4E+03
o-Cresol	D	-	2E-00	4E+03
p-Cresol	D	-	2E-00	4E+03
Cyanide	D	-	7E-01	2E+03
Cyanogen	D	-	1E-00	3E+03
Cyanogen bromide	D	-	3E-00	7E+03
DDD	B2	-	1E-04	3E-00
DDE	B2	-	1E-04	2E-00
DDT	B2	1E-02	1E-04	2E-00
Dibutyl phthalate	D	-	4E-00	8E+03
Dibutyl nitrosamine	B2	6E-04	6E-06	1E-01
Dichlorobenzidine	B2	-	8E-05	2E-00

* Detection levels should be comparable to those required by U.S. EPA's Contract Laboratory Program (CLP).

Appendix A: Examples of Concentrations Meeting Criteria for Action Levels
(Section 264.521(a)(2)(i-iv))

Constituent Name	Class	Air (ug/m ³)	Water (mg/L)	Soils (mg/kg)
<hr/>				
Dichlorodifluoromethane	D	2E+02	7E-00	2E+04
1,2-Dichloroethane	B2	4E-02	(1)	8E-00
1,1-Dichloroethylene	C	3E-02	(1)	1E+01
2,4-Dichlorophenol	D	-	1E-01	2E+02
2,4-Dichlorophenoxyacetic acid	D	-	4E-01	8E+02
1,3-Dichloropropene	B2	-	1E-02	2E+01
Dieldrin	B2	2E-04	2E-06	4E-02
Diethyl phthalate	D	-	3E+01	6E+04
Diethylnitrosamine	B2	2E-05	2E-07	5E-03
Dimethoate	D	-	7E-01	2E+03
Dimethylnitrosamine	B2	7E-05	7E-07	1E-02
m-Dinitrobenzene	D	-	4E-03	8E-00
2,4-Dinitrophenol	D	-	7E-02	2E+02
2,3-Dinitrotoluene (and 2,6-, mixture)	B2	-	5E-05	1E-00
1,4-Dioxane	B2	-	3E-03	6E+01
Diphenylamine	D	-	9E-01	2E+03
1,2-Diphenylhydrazine	B2	4E-03	4E-05	9E-01
Disulfoton	D	-	1E-03	3E-00
Endosulfan	D	-	2E-03	4E-00
Endothall	D	-	7E-01	2E+03
Endrin	D	-	(1)	2E+01
2,2,4-Trichlorohydrin	B2	8E-01	4E-03	7E+01
1,2-Dibromobenzene	D	-	4E-00	8E+03
1,2-Dibromobenzene	B2	5E-03	4E-07	8E-03
Formaldehyde	B1	8E-02	-	-
Formic acid	D	-	7E+01	2E+05
Glycidyaldehyde	D	-	1E-02	3E+01
Heptachlor	B2	8E-04	8E-06	2E-01
Heptachlor epoxide	B2	4E-04	4E-06	8E-02
Hexachlordibenzo-p-dioxin	B2	6E-07	1E-08	1E-04
Hexachlorobutadiene	C	4E-01	4E-03	9E+01
alpha-Hexachlorocyclohexane	B2	6E-04	6E-06	1E-01
beta-Hexachlorocyclohexane	C	2E-02	2E-04	4E-00
Hexachlorocyclopentadiene	D	7E-02	2E-01	6E+02
Hexachloroethane	C	3E-00	3E-02	8E+01
Hexachlorophene	D	-	1E-02	2E+01
Hydrazine	B2	2E-04	1E-05	2E-01
Hydrogen cyanide	D	-	7E-01	2E+03
Hydrogen sulfite	D	-	1E-01	2E+02
Isobutyl alcohol	D	-	1E+01	2E+04
Isophorone	C	-	9E-02	2E+03
Lead	B2	-	(1)	-
Lindane (gamma-hexachlorocyclohexane)	B2/C	-	(1)	5E-01
m-Phenylenediamine	D	-	2E-01	5E+02
Maleic anhydride	D	-	4E-00	8E+03
Maleic hydrazide	D	-	2E+01	4E+04
Manganese (inorganic)	D	-	(1)	2E+01

Appendix A: Examples of Concentrations Meeting Criteria for Action Levels
(Section 264.521(a)(2)(i-iv))

Constituent Name	Class	Air ($\mu\text{g}/\text{m}^3$)	Water (mg/L)	Soils (mg/kg)
<hr/>				
Methacrylonitrile	D	7E-01	4E-03	8E-00
Methomyl	D	-	9E-01	2E+03
Methyl chlorocarbonate	D	-	-	-
Methyl ethyl ketone	D	3E+02	2E-00	4E+03
Methyl isobutyl ketone	D	7E+01	2E-00	4E+03
Methyl parathion	D	-	9E-03	2E+01
Methylene chloride	B	3E-01	5E-03	9E+01
n-Nitroso-di-n-butylamine	B2	6E-04	6E-06	1E-01
n-Nitroso-n-ethylurea	B	-	-	-
n-Nitroso-n-methylethylamine	B2	-	2E-06	3E-02
n-Nitrosodi-n-propylamine	B2	-	5E-06	1E-01
n-Nitrosodiethanolamine	B2	-	1E-05	3E-01
n-Nitrosodiphenylamine	B2	-	7E-03	1E+02
n-Nitrosopyrrolidine	B2	2E-03	2E-05	3E-01
Nickel	D	-	7E-01	2E+03
Nickel refinery dust	A	4E-03	-	-
Nitric oxide	D	-	4E-00	8E+03
Nitrobenzene	D	2E-00	2E-02	4E+01
Nitrogen dioxide	D	-	4E+01	8E+04
Osmium tetroxide	D	-	4E-04	8E-01
Parathion	C	-	2E-01	5E+02
p,p'-Dichlorobenzene	D	-	3E-02	6E+01
p,p'-Dichloronitrobenzene	C	1E-01	1E-01	2E+02
p,p'-Dichlorophenol	D	-	1E-00	2E+03
Phenol	D	-	2E+01	5E+04
Phenyl mercuric acetate	D	-	3E-03	6E-00
Phosphine	D	-	1E-02	2E+01
Phthalic anhydride	D	-	7E+01	2E+05
Polychlorinated biphenyls	B2	-	5E-06	9E-02
Potassium cyanide	D	-	2E-00	4E+03
Potassium silver cyanide	D	-	7E-00	2E+04
Pronamide	D	-	3E-00	6E+03
Pyridine	D	-	4E-02	8E+01
Selenious acid	D	-	1E-01	2E+02
Selenourea	D	-	2E-01	4E+02
Silver	D	-	(1)	2E+02
Silver cyanide	D	-	4E-00	8E+03
Sodium cyanide	D	-	1E-00	3E+03
Strychnine	D	-	1E-02	2E+01
Styrene	C	-	7E-00	2E+04
1,1,1,2-Tetrachlorethane	C	1E-00	1E-02	3E+02
1,2,4,5-Tetrachlorobenzene	D	-	1E-02	2E+01
1,1,1,2-Tetrachloroethane	C	1E-00	1E-02	3E+02
1,1,2,2-Tetrachloroethane	C	2E-01	2E-03	4E+01
Tetrachloroethylene	B2	1E-00	7E-04	1E+01
2,3,4,6-Tetrachlorophenol	D	-	1E-00	2E+03
Methyl lead	D	-	4E-06	8E-03

Appendix A: Examples of Concentrations Meeting Criteria for Action Levels
(Section 264.521(a)(2)(i-iv))

Constituent Name	Class	Air (ug/m ³)	Water (mg/L)	Soils (mg/kg)
Tetraethyldithiopyrophosphate	D	-	2E-02	4E+01
Thallic oxide	D	-	2E-03	6E-00
Thallium acetate	D	-	3E-03	7E-00
Thallium carbonate	D	-	3E-03	6E-00
Thallium chloride	D	-	3E-03	6E-00
Thallium nitrate	D	-	3E-03	7E-00
Thallium sulfate	D	-	3E-03	6E-00
Thiosemicarbazide	D	-	2E-01	5E+02
Thiram	D	-	2E-01	4E+02
Toluene	D	7E+03	1E+01	2E+04
Toxaphene	B2	3E-03	(1)	6E-01
1,2,4-Trichlorobenzene	D	1E+01	7E-01	2E+03
1,1,1-Trichloroethane	D	1E+03	3E-00	7E+03
1,1,2-Trichloroethane	C	6E-01	6E-03	1E+02
Trichloroethylene	B2	-	(1)	6E+01
Trichloromonofluoromethane	D	7E+02	1E+01	2E+04
2,4,5-Trichlorophenol	D	-	4E-00	8E+03
2,4,6-Trichlorophenol	B2	2E-01	2E-03	4E+01
2,4,5-Trichlorophenoxyacetic acid	D	-	(1)	8E+02
1,2,3-Trichloropropane	D	-	2E-01	5E+02
Vanadium pentoxide	D	-	3E-01	7E+02
Vanadates	D	1E+03	7E+01	2E+05
Cyanide	D	-	2E-00	4E+03
Zinc phosphide	D	-	1E-02	2E+01

(1) MCL available; see Appendix B.

(2) The air action level for asbestos is measured in units of fibers/mililiters.

(3) There is an MCL for total trihalomethanes, which includes four constituents: bromoform, bromodichloromethane, chloroform, and dibromochloromethane. Concentration derived using exposure assumptions in Appendix D and reference doses for systemic toxicants and verified risk-specific doses at 10⁻⁶ for Class A and B carcinogens and 10⁻⁵ for Class C carcinogens (see section VI.F.2.6 for further discussion).

A, B and C represents class A, B and C carcinogens, respectively; D represents a systemic toxicant.

1.3 ~~Initial Soil Contaminant Characterization~~ Previous Sampling Activities

During the sampling visit (SV) phase of the Versar, Inc. RCRA Facility Assessment (RFA), soil samples were collected to identify releases from the SWMUs identified during the PR and VSI portions of the RFA. ~~or potential releases from the SWMU's. The SV portion of the RFA produced results which triggered EPA to determine that a release had occurred.~~ Samples were collected from the waste oil storage area, the raw product storage area, the drainage swale southwest of the raw product storage area, the hazardous waste storage area, and the scrap metal waste bin area (Figure 1). Two background soil samples also were collected. All samples were analyzed for semi-volatile organics and total metals.

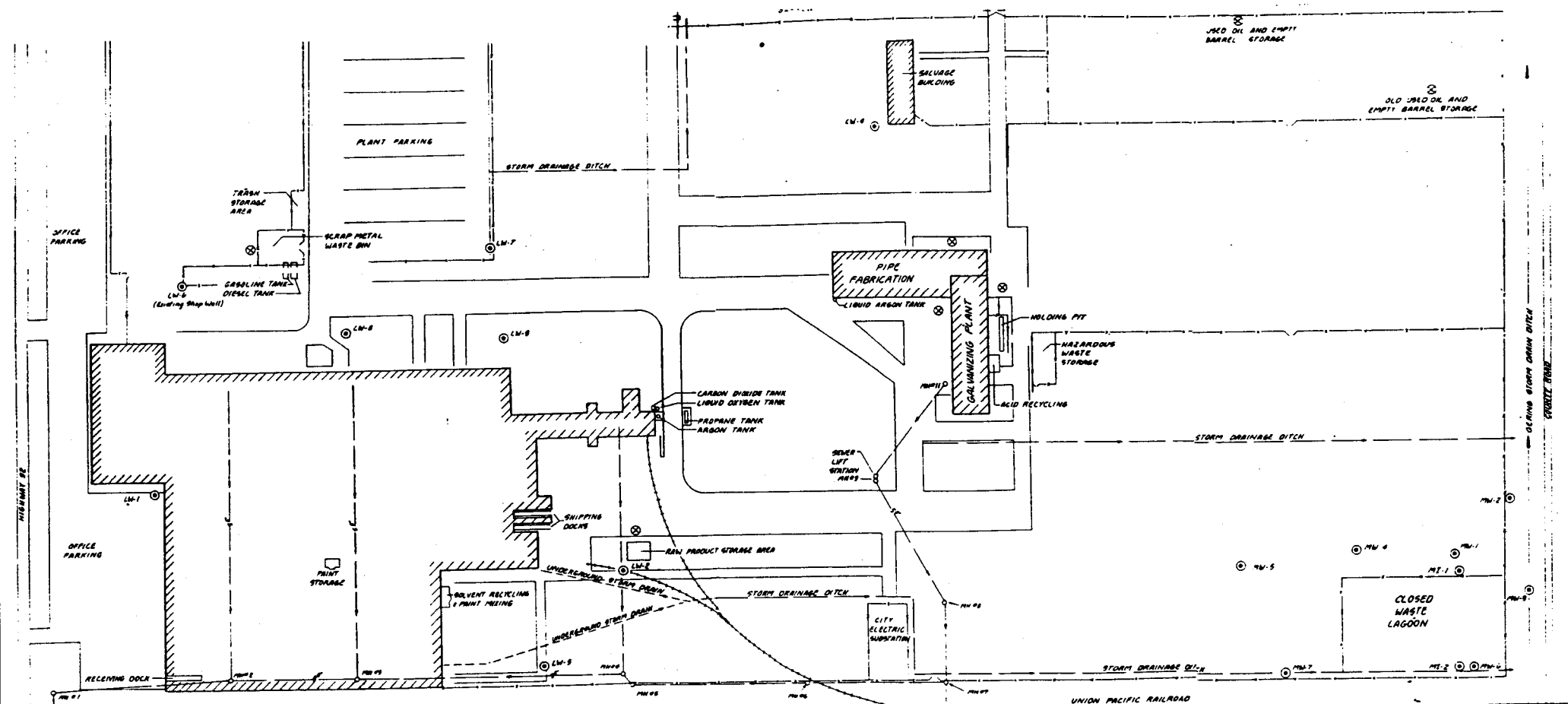
No semi-volatile organic compounds were detected in the background soil samples. For several samples, the detection limits for the semi-volatile organic compounds were extremely high (25-240 ppm). As a result, very few semi-volatile organic compounds were detected in the soil samples. Based on this fact, it is necessary to resample and analyze for semi-volatile organic compounds in the surface soil. Concentrations of metals in the soil samples were compared with background values to determine whether a release from a unit had occurred. Individual results of this sampling effort are discussed below under each specific area heading.

~~1.3.1 SWMU Characterization~~

~~It is Lockwood's intention that this Phase I initial sampling and analysis activity will verify the presence or absence of releases from the designated SWMU's.~~

~~Soil samples will be collected continuously to a depth of seven (7) feet in five (5) boreholes at each SWMU. Samples will be collected using a drill rig and hollow stem auger with a continuous sampler. The continuously collected soil sample will be logged by a qualified geologist using the Unified Soil Classification System. A soil sample will be collected for chemical analyses at three (3) feet and seven (7) feet from each continuous sample. A pilot boring will also be collected continuously to the Brule (twenty (20) to forty (40) feet) in one (1)~~

FIGURE 1



LEGEND

- LN - MONITORING WELLS / ASSESSMENT
- MW - MONITORING WELLS / CLOSED
- ACID WASTE POND
- PROPOSED HYDROPLACER GROUNDWATER
- SAMPLE LOCATIONS

SOURCE: M.C. SCHAFF ASSOCIATES 1989
HOBKINS, WESTERN SONDREGGER 1989
LOCKWOOD CORP. 1989

~~borehole located near LW 1 for use in characterizing the uppermost aquifer (Section 3.0).~~

~~Background soil samples will be collected from the pilot boring for Total Select Metals, (arsenic, cadmium, chromium, lead, silver, and zinc), and volatile organics, EPA Method 8240 Long List (Table 1.0), at depths of three (3) and seven (7) feet, to assess background soil characteristics. See Sheet 1 for background soil sampling location.~~

1.4 SWMU Characterization

~~1.3.1.1~~ Hazardous Waste Storage Area

1.4.1

The gravel-covered hazardous waste storage area, is located just south of the galvanizing plant, (Figure 1). This SWMU is used to store hazardous wastes in 55 gallon drums. Waste solvents from Lockwood's painting operation and D002 sludges generated from during acid tank clean-out ~~sludges from the acid tank (D002) and waste solvents from Lockwood's painting operation.~~ are stored in this SWMU. ~~One unverified potential source of contamination was documented at this SWMU.~~ A During the SV, a white circular stain was noted on the soil surface near the center of the fenced area. (Final report - RFI, October 25, 1988). Versar collected one shallow soil sample at this point.

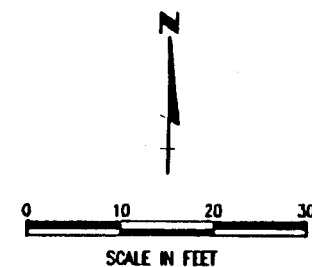
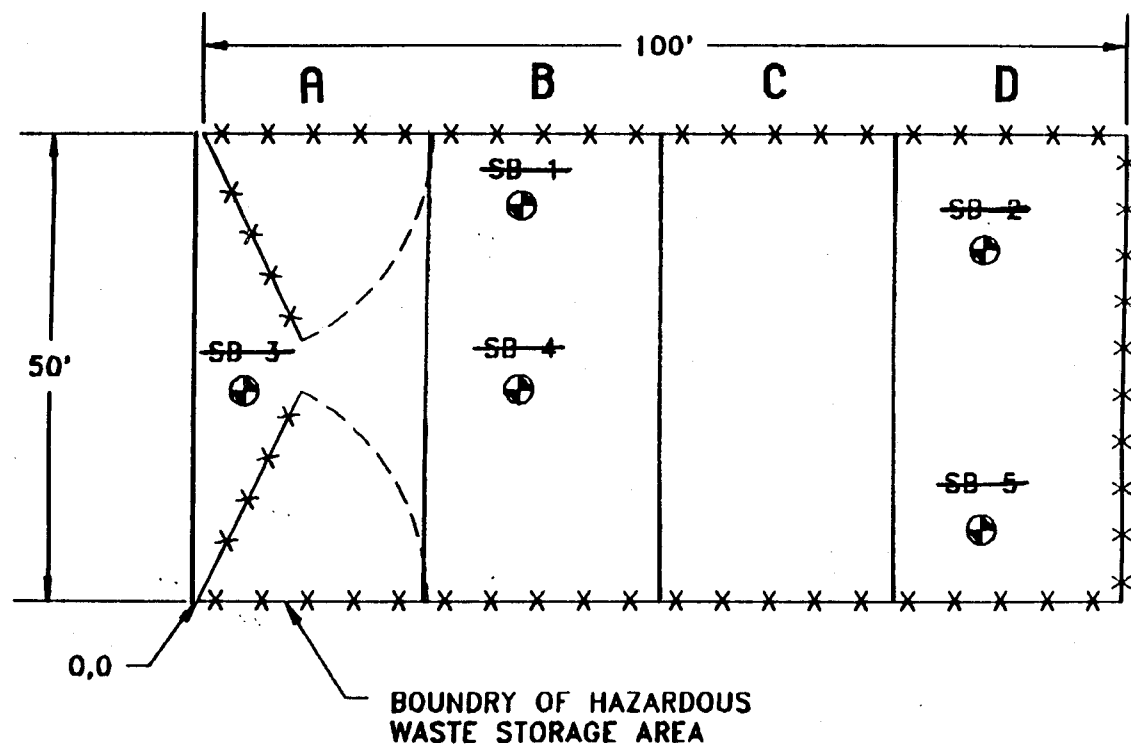
According to Versar's Final RFA Report, bis(2-ethylhexyl)phthalate was detected at a concentration of 2.1 ppm. The proposed RCRA action level for this compound is 50 ppm. Cadmium, lead, and zinc exceeded the common range for these metals in natural soils. Cadmium levels (5.1 ppm) exceeded the common range of 0.01 to 0.7 ppm, lead (600 ppm) exceeded the common range of 2 to 200 ppm, and zinc (15,000 ppm) was significantly higher than the common range of 10 to 300 ppm.

Following review of these data, Versar concluded that a release to soil in the Hazardous Waste Storage Area may be indicated by the elevated zinc levels. Versar further stated that releases from this area could potentially be transported by surface runoff or percolate to the

groundwater table. However, Versar also described the base of this area as consisting of one to two feet of compacted fine sands, rock fragments, and gravels over a natural clay base, and that the compaction of the upper layer reduces the permeability of the sand, rock, and gravel; also the basal clay may further reduce the potential for contaminants to infiltrate into the lower soils. Therefore, the focus during Phase I will be surface soils (0-6 inches depth) only.

The area of investigation for this SWMU encompasses about 7,200 square feet. ~~A drawing of the storage area including proposed sample locations can be found at Figure D 1. Samples will be collected at five (5) locations using a drill rig equipped with a 3/4 inch I.D. hollow stem auger and a continuous core barrel sampler. Each sample location will be analyzed for Select Metals (Totals for arsenic, cadmium, chromium, lead, silver, zinc), and volatile organics EPA Method 8240 Long List (Table 1.0) at depths of three (3) feet and seven (7) feet (see Table 1.3.1.1). For a complete description of sampling protocol please refer to Appendix C.~~ Figure 2 is a drawing of the storage area including proposed sample locations. The sample area will be divided into four areas of approximately 30 feet by 60 feet each. Since only one discrete sample was collected from this area during the SV and lead was reported (600 ppm) at approximately three times the upper limit of the commonly expected range (2-200 ppm), samples for selected metals will be collected in addition to semi-volatile and volatile compounds. As previously stated, semi-volatiles data reported from the SV are suspect and warrant this second sampling effort.

Sampling will consist of four composite samples made up of a randomly placed aliquot collected from each subgrid within grids A, B, C, and D. The composite from each grid will be analyzed for select metals (arsenic, cadmium, chromium, lead, silver and zinc) and semi-volatile organic compounds. Finally, two discrete samples will be collected from each grid area and analyzed for volatile organic compounds (total of eight discrete volatile organic samples). For a complete description of sampling protocol, please refer to Appendix C.



LEGEND	
SB-6	SOIL BORING
BORING LOCATIONS FROM 0,0 POINT	
SB-1	35' , 42'
SB-2	85' , 38'
SB-3	5' , 22'
SB-4	35' , 22'
SB-5	85' , 8'

Figure ~~D-1~~ 2
HAZARDOUS WASTE
STORAGE AREA

LOCKWOOD CORP
Gering, NE

HWS
Technologies Inc.

LINCOLN OFFICE
825 J St., Box 80358
Lincoln, NE 68501
402/479-2200

~~TABLE 1.3.1.1~~
~~Hazardous Waste Storage Area~~
~~Phase I Soil Sampling Protocol~~
~~Lockwood Corporation RFI~~

Number of Sample Locations ¹	Depth to Sample (ft)	Screening Method/ Analyses ²	Samples ³
5	3	EPA Method 8240, Total Select Metals	5 Soil
5	7	EPA Method 8240, Total Select Metals	5 Soil

Notes:

¹A random sampling scheme has been developed to verify the presence or absence of suspected contamination.

²Analyses chosen based on information regarding the type of waste stored in the SWMU and the results of the RFA (Table 1.0 for constituents and detection limits).

³For explanation of QA/QC procedures and sampling protocol, see Appendices C and D.

1.3.1.2. Waste Oil Storage Area

1.4.2

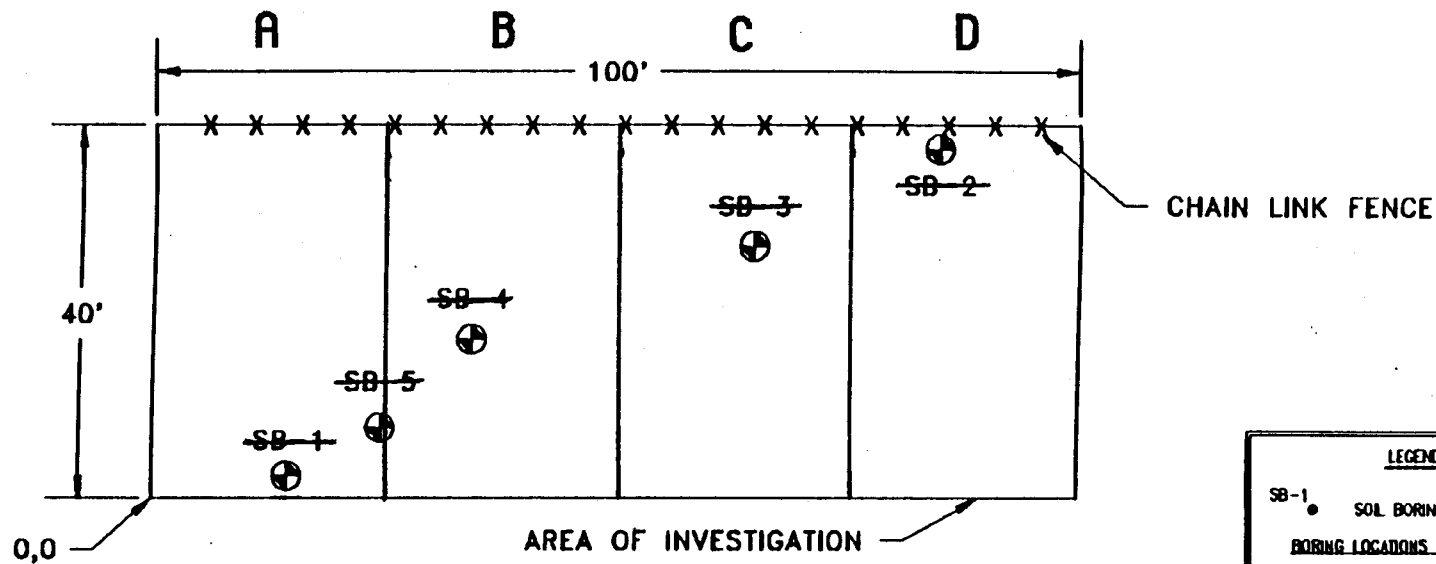
The waste oil storage area is located to the southeast within the Lockwood facility boundary along the perimeter chain-link fence (Figure 1). Waste oils and solvents had been are stored in this area on pallets prior to transport for disposal. Oil residues were noted during a site visit associated with the RFA, and in September 1987, Versar collected four shallow soil samples from the waste oil storage area. No organics were detected in any of the soil samples collected in the waste oil storage area; however, as previously noted, the detection levels for the organic compounds were high. Versar stated in their final report that this should be of concern due to the obvious oily nature of the samples collected and the distinct organic odors noted during the SV.

Metals analyses indicated that zinc was slightly elevated in two of the samples collected from the waste oil storage area (250 and 150 ppm) compared to the background level (94 ppm). The level of lead in one of the samples (40 ppm) was twice the level found in the background sample

(20 ppm); however, these data were flagged due to unapproved quality control procedures. Levels of both zinc and lead were within the common range for natural soils. Arsenic was detected in one of the samples (54 ppm) at levels slightly above the common range for natural soils (1-50 ppm). ~~Organics were not detected in any of the soil samples collected.~~

The area of investigation for this SWMU encompasses about 4,000 square feet. ~~A drawing of the storage area and proposed sampling locations can be found at Figure D-2.~~ The storage area and proposed sampling locations are shown in Figure 3. The sample area is to be divided into four areas approximately 20 feet by 40 feet each. Sampling will consist of four composite samples made up of a randomly placed aliquot within each subgrid within grids A, B, C, and D. The composite from each grid will be analyzed for select metals (arsenic, cadmium, chromium, lead, silver, and zinc) and semi-volatile organic compounds analyses. Finally, one discrete sample will be collected from each of the four areas and analyzed for volatile organic compounds.

~~Soil samples will be collected at five (5) locations using a drill rig equipped with a 3/4 inch I.D. hollow stem auger and a continuous core barrel sampler. Each sample location will be analyzed for volatile organics (EPA Method 8240 Long List, Table 1.0 at depths of three (3) feet and seven (7) feet (see Table 1.3.1.2) to verify the presence or absence of contaminants. For a complete description of sampling protocol please refer to Appendix C.~~



LEGEND	
SB-1	● SOL BORING
BORING LOCATIONS FROM O.D. POINT	
SB-1	15' , 2'
SB-2	85' , 38'
SB-3	65' , 27'
SB-4	35' , 17'
SB-5	25' , 8'

Figure ~~D-2~~ 3
WASTE OIL
STORAGE AREA

LOCKWOOD CORP
Gering, NE

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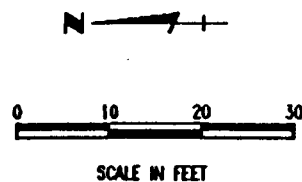


TABLE 1.3.1.2

~~Waste Oil Storage Area
Phase I Soil Sampling Protocol~~

~~Lockwood Corporation RFI~~

Number of Sample Locations¹	Depth to Sample (ft)	Screening Method/ Analyses²	Samples³
5	3	EPA Method 8240	5 Soil
5	7	EPA Method 8240	5 Soil

Notes:

¹~~A random sampling scheme has been developed to verify the presence or absence of suspected contamination.~~

²~~Analyses chosen based on information regarding the type of waste stored in the SWMU and the results of the RFA (see Table 1.0 for constituents and detection limits).~~

³~~For explanation of QA/QC procedures and sampling protocol, see Appendices C and D.~~

1.3.1.3 Scrap Metal Waste Bin Area

1.4.3

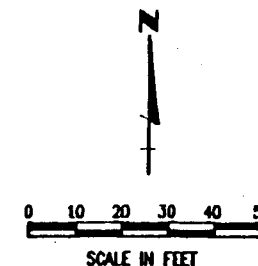
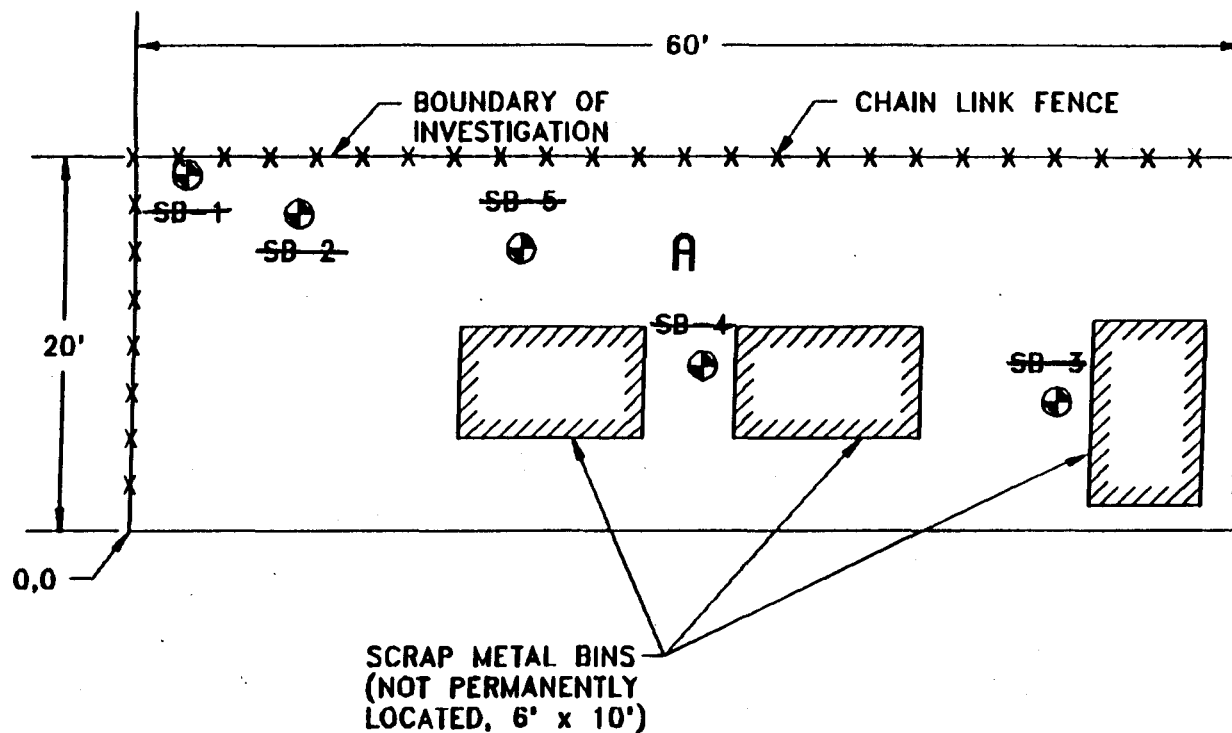
The scrap metal waste bin area east of the machine shop is surrounded on three (3) sides by a chain-link fence (Figure 1). Within the area of investigation are 3 waste bins which are, and have been used for nonhazardous waste materials (primarily scrap metal). Evidence of rust colored and oil stained soil around the bins, was noted in the RFA (final report RFA, October 25, 1988). Two shallow soil samples and a duplicate sample were collected from the ground surrounding two of the scrap metal waste bins; one located just outside the facility's eastern fence, and one sample and duplicate located just within the fence.

Bis(2-ethylhexyl)phthalate was detected in one of the samples from the scrap metal waste bin area (0.49 ppm). Samples collected from the area around the scrap metal waste bins showed elevated levels of cadmium, copper, and iron. Cadmium concentrations (10 to 21 ppm) exceeded the common range for this metal in natural soils (0.01 to 0.7 ppm); copper levels (160 to 610 ppm) also exceeded the common range for this metal (2 to 100 ppm). Iron concentrations ranged from 55,000 to 160,000 ppm,

compared to background soil values at other locations on the Lockwood facility of 9,300 to 11,000 ppm. Levels of manganese, lead, and zinc also appeared to be elevated compared to background results; however, Versar felt the data for these constituents were difficult to evaluate due to poor comparison of data from duplicate sample analyses.

The waste disposal area east of the machine shop encompasses 1,200 square feet of area. ~~A drawing of the storage area and proposed sampling locations can be found at Figure D-3.~~ Figure 4 depicts the sampling scheme for this SWMU, which will consist of one grid area subdivided into 10 foot square subgrids. As before, one aliquot will be collected randomly from each subgrid and composited for metals and semi-volatile organic compounds analyses.

~~Soil samples will be collected at five (5) locations using a drill rig equipped with a 3/4 inch I.D. hollow stem auger and a continuous core barrel sampler. Each sample location will be analyzed for volatile organics (EPA Method 8240 Long List, see Table 1.0), at depths of three (3) feet and seven (7) feet to assess the presence of contaminants (see Table 1.3.1.4).~~ Each composite sample will be analyzed for select metals (arsenic, cadmium, chromium, lead, silver, and zinc) and semi-volatile organic compounds. Finally, one discrete sample will be collected from each grid and analyzed for volatile organic compounds. For a complete description of sampling protocol please refer to Appendix C.



LEGEND	
SB-1	SOIL BORING
BORING LOCATIONS FROM 0,0 POINT	
SB-1	19' . 60"
SB-2	25' . 58"
SB-3	88' . 48"
SB-4	47' . 50"
SB-5	37' . 58"

Figure ~~D-3~~ 4
SCRAP METAL WASTE BIN AREA
EAST OF MACHINE SHOP

LOCKWOOD CORP
Gering, NE

HWS
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~~TABLE 1.3.1.3~~

~~Scrap Waste Bin Area~~

~~Phase I Soil Sampling Protocol~~

~~Lockwood Corporation RFI~~

Number of (ft)	Depth to	Screening Method/	Sample Locations	Sample
Analyses	2	Samples	3	3

5	3	EPA Method 8240,	5 Soil
		Total Select	
		Metals	

5	7	EPA Method 8240,	5 Soil
		Total Select	
		Metals	

Notes:

~~1A random sampling scheme has been developed to verify the presence or absence of suspected contamination.~~

~~2Analyses chosen based on information regarding the type of waste stored in the SWMU and the results of the RFA (Table 1.0 for constituents and detection limits).~~

~~3For explanation of QA/QC procedures and sampling protocol, see Appendices C and D.~~

~~1.3.1.4. Raw Product Storage Area~~

~~1.4.4~~

The raw product storage area is located approximately 150 feet to the south of the southeast portion of the main plant (Figure 1), and houses chemical products including paints, gear oils, lubricants and various solvents. The chemical materials are stored in drums, cans, or tanks and are kept on a concrete pad. Visual evidence of soil

discoloration of the surface soil and oil residues surrounding some of the drums were noted in the RFA (final report RFA, October 25, 1988).

Two shallow soil samples were collected in the Raw Product Storage Area. One sample was collected near the storage drums in this area where the soil appeared oily. A second sample was collected from near the drainage area from the line stripper solvent tank where the soil appeared yellow and caked. A background soil sample was collected along the western fenceline near the Raw Products Storage Area.

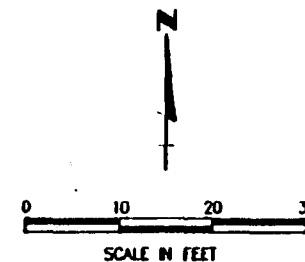
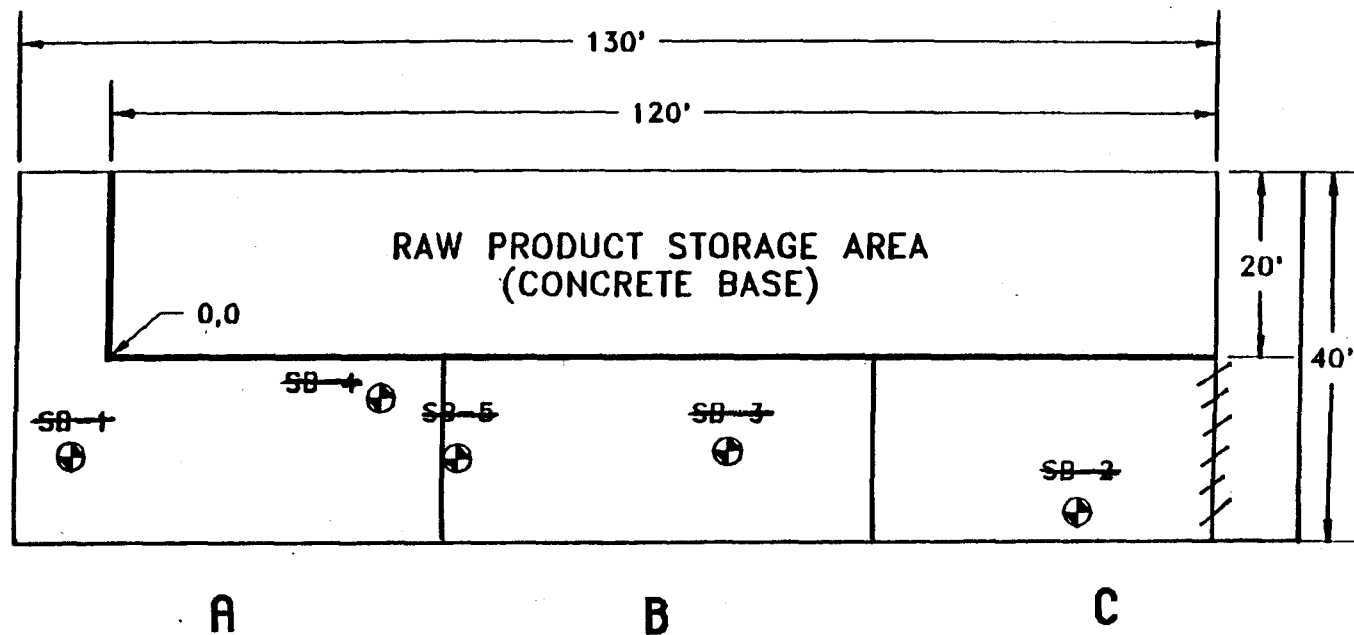
Naphthalene (540 ppm and 7.3 ppm) and 2-methylnaphthalene (110 ppm and 4.8 ppm) were detected in both samples collected from the Raw Product Storage Area. Although action levels for naphthalene and 2-methylnaphthalene have not been proposed under RCRA at this time, both compounds are considered polynuclear aromatic hydrocarbons (PAHs) and cleanup levels for specific sites under the CERCLA program have been established. The CERCLA program in Region VII is currently considering total PAHs of 500 ppm or greater at former coal gas facilities to represent a dermal contact threat requiring remediation. Based on this, further investigation of the naphthalene and 2-methylnaphthalene detected at this SWMU needs to be conducted.

Levels of arsenic, chromium, lead, and zinc exceeded the levels detected in the background sample from this area. Elevated levels of these same metals were also detected in the sample collected from the drainage area. Although the data for lead were flagged because of inadequate quality control, lead values reported for the two samples collected from the Raw Product Storage Area and the drainage area (306, 204, and 600 ppm, respectively) were significantly higher than the background sample (12 ppm) and exceeded the common range for lead in natural soils (2 - 200 ppm). Arsenic was detected in all three samples (15, 26, and 42 ppm, respectively) but was not detected in the background sample. Chromium was detected in the three samples (76, 35, and 43 ppm, respectively) at levels higher than in background soils (11 ppm). Zinc was detected at a significantly higher concentration in the second sample collected from the Raw Product Storage Area (300 ppm) than was detected in

the background soil sample (52 ppm).

Although the metals reported did not exceed proposed RCRA action levels, they did exceed background levels and indicate a release(s) has occurred. Since the objective of the SV was simply to identify potentially contaminated areas, the extent of contamination at this SWMU has not been adequately defined horizontally for metals contamination and this parameter will be analyzed during this phase of investigation.

The area of investigation for this SWMU encompasses about 2,800 square feet, and consists of areas adjacent to the concrete storage pad. ~~A drawing of the raw product storage area and proposed sampling locations can be found at Figure D-4.~~ Figure 5 depicts the sampling scheme for this SWMU, which consists of three subgrids. The composite from each grid will be analyzed for select metals (arsenic, cadmium, chromium, lead, silver, and zinc) and semi-volatile organic compounds. One discrete sample will be collected from each of the three areas and analyzed for volatile organic compounds. For a complete description of sampling protocol, please refer to Appendix C.



LEGEND	
SB-1	SOIL BORING
WELL LOCATIONS FROM 0,0 POINT	
SB-1	-4', -11'
SB-2	105', -17'
SB-3	68', -11'
SB-4	30', -4'
SB-5	38', -11'

Figure D-4 5
RAW PRODUCT
STORAGE AREA

LOCKWOOD CORP
Gering, NE

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~~TABLE 1.3.1.4~~

~~Raw Product Storage Area
Phase I Soil Sampling Protocol~~

~~Lockwood Corporation RFI~~

Number of (ft) Analyses ²	Depth to Samples ³	Screening Method/	Sample Locations ¹	Sample
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5	3	EPA Method 8240	5	Soil
--------------	--------------	----------------------------	--------------	-----------------

5	7	EPA Method 8240	5	Soil
--------------	--------------	----------------------------	--------------	-----------------

~~Notes:~~

~~1A random sampling scheme has been developed to verify the presence of suspected contamination.~~

~~2Analyses chosen based on information regarding the type of waste stored in the SWMU and the results of the RFA (see Table 1.0 for constituents and detection limits).~~

~~3For explanation of QA/QC procedures and sampling protocol, see Appendices C and D.~~

~~1.3.1.5 Other Stained or Discolored Areas~~

~~1.4.5~~

~~Other stained or discolored areas within the Lockwood facility boundary will be investigated if and when it is apparent that routine and systematic releases from SWMU's have occurred.~~

As required by Permit Condition V.B.1.b, soil samples will be collected from areas at the Lockwood facility where soils are visibly stained or discolored. As stated in U.S. EPA's letter dated July 8, 1991, the primary mechanism for determining the location of these areas will be based on the potential for routine and systematic release of hazardous

constituents from the handling of raw products or hazardous wastes at various locations throughout the facility.

Since these areas have not yet been determined or sampled in the past, it will be necessary to analyze for metals along with volatile and semi-volatile organic compounds. Once individual areas are identified, discrete samples for obviously stained or discolored areas will be sampled. If contamination is discovered, the next step will involve grid sampling for surface soils as described under Phase I.

1.5 Sampling and Analysis Quality Assurance and Quality Control (QA/QC)

~~The purpose of the data collected from sampling and analysis in and adjacent to the solid waste management units during the Phase I Study is to evaluate the following:~~

- ~~◆ the existence of contaminants.~~
- ~~◆ the initial screening of contaminant levels compared to EPA Subpart S Action Levels.~~
- ~~◆ the need for further corrective actions, i.e., Phase II sampling at each of the designated SWMU's.~~

The purpose of Phase I of this RFI is to obtain data from sampling the SWMUs and surrounding areas described in Section 1.0. These data will be used to:

- o Characterize the surface soils from the identified SWMUs
- o Define the horizontal extent of contamination for each SWMU
- o Determine whether any potential threats to human health or the environment exist warranting implementation of interim measures
- o Determine whether sufficient contamination is present to justify development and implementation of Phase II.

Data generated as a result of the Phase I investigation must be of a form necessary to make reliable and valid decisions regarding potential need for further Phase II sampling at the subject SWMU's. In order to conform to these criteria, data generated must be reliable, valid, precise, accurate, representative, complete, and comparable in order to facilitate the appropriate quality in the form of Assurances and Controls.

A complete listing of QA/QC information including a description of QA objectives for measurement of data in terms of precision, accuracy, representativeness, completeness, and comparability can be found at Appendices C and D.

**PHASE I
SECTION 2.0
ITEM V.B.a.1.
EVALUATION OF EXISTING MONITORING
WELLS**

2.1 Introduction

There are presently 17 monitoring wells and one shop well on-site at the Lockwood Corporation facility at Gering, Nebraska. Ten monitoring wells were installed in October 1985 near the closed spent acid evaporation pond, located in the southwest corner of the facility, and are designated with MW and MI prefixes. Seven monitoring wells were installed in November 1989 in various locations throughout the facility as part of a lending institution's assessment of the site, and are designated with LW prefixes.

Monitoring wells were constructed using a drill rig equipped with either a mud rotary drill or a hollow stem auger. Threaded PVC casing and screen was placed in each well with the screened interval located at the bottom of each hole. A cap was placed on the end of each screen. All monitoring wells are screened in and receive water from a clean to silty, fine- to medium-grained sand, or a clean to silty sand and gravel deposit. Records indicate that no wells have been abandoned on this site.

Evaluation and verification of the facility monitoring wells was accomplished by a site visit, compilation and examination of drilling logs and well construction details, and interviews with key personnel involved with the design and installation of the wells. Well construction and surveying methods are explained in this report. Monitoring well data are tabulated in Appendix E and drilling logs and construction figures are presented as Appendix A and B.

2.2 Elevations

All wells on site, with the exception of LW-7 and LW-8, were re-surveyed in November 1989 for location, top of PVC casing elevation, and ground elevations by M.C. Schaff and Associates, Scottsbluff, Nebraska. A Soil Conservation Service (S.C.S.) "chiseled cross" located on a concrete culvert near the southeast corner of the facility was used as a benchmark for all surveys. Top of casing elevations were taken from an etched mark located on the north side of the PVC casing. Ground elevations were taken from the concrete base directly below the top of the casing mark. Information on elevations is listed in the Monitoring Well Data Table, (Appendix C). Surveyed locations shall be incorporated into the facility site map.

2.3 Verification Of Screen Placement

Verification that wells are stratigraphically in the formation depicted, and that well screens are of appropriate length, was accomplished by examination of existing boring logs and well construction forms, and interviews with personnel on site during well installation.

Examination of drilling logs and well construction details show that screens are located in alluvial sediments which overlie the less permeable clays and siltstones of the Brule Formation. Although some screen is located 1 to 2 feet into the Brule Formation, it is prudent to assume that the majority of the groundwater flowing into the wells is from the more permeable sand and gravel deposits which overlie the Brule.

Monitoring Wells MW 1-8 and MI 1 and 2 were installed to obtain water samples for analysis of metal contamination and, therefore, were constructed with 10 feet of screen at the bottom of the alluvial deposits. Monitoring wells LW 1-5 and LW 7 and 8 were installed to obtain general groundwater quality information and, therefore, have 10 to 20 feet of screen located at various depths in the alluvial deposits.

Drilling logs describing drilling methods, well construction, and formation material intercepted by the screens for the MW and MI wells are given in Appendix D. Drilling logs for monitoring wells LW 1-5 are given in Appendix E.

2.4 Monitoring Well Construction Methods

Monitoring wells MW 1 through 8 were constructed in October 1985 using a rotary drill rig and sodium bentonite drilling fluid. Four-inch threaded PVC was installed in each of these holes with 10 feet of 0.010 slotted screen placed at the bottom of each well. A steam cleaner was used to clean all downhole equipment. No solvents were used.

A 16/40 filter sand was then installed to a depth of 2 feet above the top of the screen. Four sacks of bentonite were added to each hole as a seal. This amount of bentonite equals approximately 2 to 4 feet of bentonite per hole. A concrete seal was added to each well from the top of the bentonite seal to grade. Monitoring/interceptor wells MI-1 and MI-2 were also drilled in October 1985 using the same method but with 6-inch PVC casing and screen. A locking 5 foot outer steel protective cover was placed over wells MW-1 through 8 and MI 1 and 2 from approximately 2.5 feet below grade to 2.5 feet above grade.

Monitoring wells LW 1-5 were drilled using a rotary drill rig and sodium bentonite drilling fluid. Two-inch PVC 4 square threaded casing was used to construct these wells, with 10 to 20 feet of 0.010 slotted screen placed at the bottom of each well. All LW wells were connected by threads without the use of solvents. A bottom plug was used in each LW well. Well LW-6 was an existing shop well which is still in use. No drilling logs or construction notes are available for this well. Monitoring wells LW-7 and 8 were installed using a hollow stem auger, 16/40 filter sand, 2-inch PVC, bentonite seal and concrete seal. No drilling logs exist for LW-7 and 8. A surface protector, set in concrete with a locking cap was placed over monitoring wells LW 1-5 and LW-7 and 8 (see Appendix B for construction details). No solvents were used during construction of the LW wells. A steam cleaner was used to clean all downhole equipment.

Personnel involved with drilling the above wells at Lockwood are listed below:

Don Kuhlman, P.E.
HWS Technologies Inc.
825 J Street
Lincoln, Nebraska

Gene Nelson
Nelson Well Drilling
Alliance, Nebraska

Jamie Hurtz
Water and Air Research
Gainesville, Florida

Clint Schaff, P.E.
M.C. Schaff and Associates
Scottsbluff, Nebraska

Prepared by:

Reviewed by:

Tom O'Connor
Senior Hydrogeologist

Erwin G. Kirkvold, P.E.
Environmental Engineer

PHASE I
SECTION 3.0
ITEM V.B.a.2.

CHARACTERIZATION PLAN FOR UPPERMOST AQUIFER

3.1 Introduction

The purpose of the characterization plan for the uppermost aquifer is to define the geologic and hydrogeologic parameters that may influence the migration of any possible groundwater contaminants at Lockwood. The principal aquifer in this area has been defined by the Nebraska Conservation and Survey Division (CSD), and the Nebraska Department of Environmental Control (NDEC) as being composed of the Arikaree and Ogallala Groups of Tertiary age, and overlying unconsolidated deposits of Quaternary age (CSD, 1980). Erosion of the Arikaree and Ogallala Groups along the Platte Valley has left the unconsolidated Quaternary age sand and gravel alluvium in direct contact with the underlying Brule Formation. While generally composed of massive or finely laminated silt and siltstone, the Brule may weather into a blocky structure, developing a secondary permeability.

Because some uncertainty exists as to whether the siltstone and claystone of the upper Brule Formation acts as an aquitard to the overlying sand and gravel unit, a phased approach to characterizing the aquifer is recommended. This phased approach involves first defining the geologic, ~~and~~ hydrogeologic, and groundwater quality characteristics of the sand and gravel unit, the upper weathered Brule sediments, and regional features of the Brule. If data obtained by this first phase of investigation warrants further study, information will be obtained on the geologic and hydrogeologic features of the Brule Formation, as well as groundwater quality within the Brule. ~~at Lockwood will be obtained.~~

3.2 Methods of Investigation

Characterization of the uppermost sand and gravel and the upper weathered Brule (top 2 feet) will be accomplished by drilling a background pilot boring near LW-1 through the base of the sand and gravel aquifer into the top 2 feet of the Brule, using a hollow-stem auger and a continuous sampler during the initial verification sampling (Section 1.0). If problems occur in retrieving adequate samples of unconsolidated sand and gravel deposits with a continuous sampler, a split spoon sampler with a sand trap will be substituted for the continuous sampler. The borehole will be drilled until the upper weathered Brule is encountered, approximately 20 feet to 40 feet in depth. Upon completion of drilling and sampling the pilot boring, the borehole will be backfilled using a grout mixture consisting of 2-6 percent by weight bentonite and Portland cement, placed using a tremie pipe.

Logging of soil samples will be performed by a qualified geologist. A field logging form, utilizing a scale of 1 inch = 1 foot, will be used in order to attempt to identify thin zones of subsurface materials that may influence contaminant migration. Logs will indicate the types of drilling and sampling equipment used, the sampled intervals, and the amounts of sample recovery from each interval. Borehole depth information and the locations of all lithologic/stratigraphic changes will be determined by direct measurement to a precision of 0.1-foot. The locations of all stratigraphic/lithologic changes will be clearly identified on the log by solid horizontal lines across the "Description of Materials" column which indicate the interval of each distinct subsurface unit encountered. Logs will identify the depth at which water is first encountered, as well as the depth to water at the completion of drilling.

Maps depicting the extent of the sand and gravel unit and the top of the weathered Brule will be compiled using data obtained from the planned pilot boring, the logs from the existing wells, information obtained from past reports on the site-, and logs prepared during drilling for the new monitoring wells.

In-situ slug tests will be performed on four existing monitoring wells (MW-4, MW-8, LW-4, and LW-5). Slug tests will be accomplished by suddenly removing or injecting a known volume of water from or into the well (EPA Method

9100). Estimates for hydraulic conductivity and transmissibility of the aquifer can then be estimated using the following equations:

$$K = \frac{rc^2 \ln(\bar{R}/rw)}{2 L_e t} \quad \frac{\ln Y_0}{Y}$$

where:

K = Hydraulic conductivity

L_e = Height of saturated screen

rc = Radius of casing

rw = Radius of screen or borehole

t = Time

Y = Static water level

Y_0 = Water level at time = 0

\bar{R} = Effective radius

and $T = Kb$

where:

T = Transmissivity

K = Hydraulic conductivity

b = Aquifer thickness

3.3 Sample Collection and Testing

During drilling of the deep pilot borehole, a representative sample of fines, coarse sand and gravel, and weathered Brule will be collected and analyzed in the laboratory for particle size. Samples of subsurface material will be collected continuously from ground surface to termination of the boring in order to prepare detailed logs. ~~Portions of the continuously collected sample will be collected for laboratory analyses (particle size).~~ Samples for grain size analysis will be collected from the two zones where the new wells will be screened, i.e. the upper five feet of the saturated zone, and the lower five feet of the unconsolidated zone. The field geologist will decide, based upon visual observations, which portions of the continuous sample will be analyzed. However, a minimum of three (3) samples will be collected and analyzed from the pilot boring. Upon completion of drilling and sampling the pilot boring, the borehole will be backfilled using a grout mixture consisting of 2-6 percent by weight bentonite and Portland cement, placed using a tremie pipe.

3.4 Characterization of the Brule Formation

The underlying Brule Formation is more difficult to characterize than the overlying sand and gravels for the following reasons: 1) no monitoring wells at the site have been screened solely in the Brule; 2) permeability associated with the Brule may be due to local secondary porosity features, and 3) upper siltstone and claystone deposits of the Brule may act as an aquitard to the overlying alluvium.

A thorough review of available data including publications, theses, and dissertations on the Brule in this area will be undertaken, in order to define regional geologic and hydrogeologic characteristics. Features of interest include regional fracturing or regional lineation of secondary permeability, regional transmissivity values, and regional distribution of low or high permeability deposits.

~~Drilling and construction of monitoring wells in the Brule Formation is not recommended at this time. Monitoring wells or boreholes drilled in the Brule may not intercept secondary permeability features, and drilling through the upper Brule will puncture deposits which now may be acting as an aquitard. Penetration of a lower confining unit may create a conduit for the potential migration of contaminants into deeper deposits below the alluvium.~~

If initial drilling and sampling reveal contaminants in the upper weathered Brule deposits or in the base of the sand and gravel unit, further study of the hydrogeologic and groundwater quality characteristics of the Brule will be undertaken. Further study of the Brule would possibly involve downhole geophysical techniques and pump tests in deep test holes or monitoring wells. Additional work may also involve the use of specialized multi-cased drilling and well installation techniques in order to install wells within the Brule while ensuring that contaminants are not introduced into it. A complete plan for characterizing zones of fracturing or higher permeability in the Brule will be submitted, if necessary, after initial studies have been completed.

PHASE I
SECTION 4.0
SCHEDULE FOR PHASE I IMPLEMENTATION

4.1 Schedule for Implementation (Phase I)

4.1.1 Soils and Sediment

Within 30 ~~Thirty~~ days after workplan approval, ~~initial~~ Phase I soil sampling ~~and characterization of the upper aquifer will commence~~ commence. Phase I soil sampling results ~~and upper aquifer characterization results~~ will be completed and reported to the EPA within 45 days following initiation of sampling.

4.1.2 Characterization of Uppermost Aquifer

Within 30 days after workplan approval, drilling and sampling of the pilot hole near LW-1 will commence.

PHASE II
SECTION 5.0
ITEM V.B.1.b.
SOIL CHARACTERIZATION PLAN

5.0 Introduction

5.1

The purpose of this plan is to define the extent of those contaminants found during the Phase I initial screening/verification sampling at the Lockwood facility in Gering, Nebraska, which exceed EPA action levels (Table 1.0, Section 1.0). It is Lockwood's intention that the subject Soil Characterization Plan (Section 5.0) will adequately address all concerns as outlined in the Nebraska Department of Environmental Control (NDEC)/U.S. Environmental Protection Agency (EPA) Post Closure Permit for Lockwood Corporation Closed Waste Acid Lagoons, issued September 29, 1989, and effective October 29, 1989, Part V.B.1.b.

5.2 Site Soil Characteristics (Geotechnical Analyses)

Surface soil characteristics on-site can generally be described as a silty clay/silty sand with 10-15% fine sand, dark brown, moist, and low plasticity to a depth of about 3 feet. From approximately 3-10 feet the soils are characterized by sand (fine to coarse, 5-15% fines, brown) or silty sand (30-45% fines, fine to coarse, brown). Additional soil characterization will be obtained in accordance with Table 5.2 at the pilot boring located adjacent to LW-1 if Phase I reveals contaminants in excess of proposed EPA Action levels.

TABLE 5.2
Soil Characterization (Phase II)
Geotechnical Analyses

Parameter	Methodology
SCS soil classification, particle size distribution	-Sieve analysis (ASTM C136) -Atterburg limits (ASTM D4318) -Literature
Soil profile	-Boring logs
Relative permeability porosity	-Slug test Winger, R.J., 1960, In-place permeability tests and their use in subsurface drainage, International Commission of Irrigation and Drainage, Madrid, or equivalent.
Cation exchange capacity	-CEC of soils (Sodium acetate, EPA Method 9081)
Soil pH	-Flat Electrode
Particle size distribution	-Sieve Analysis (ASTM C136)
Moisture content	-Nuclear density
Mineral content	-Clay Mineralogy (XRD) Gibbs, R.J., 1971, x-ray diffraction mounts: in Carver, R.E., ed., Procedures in Sedimentary Petrology, Wiley-Interscience, New York, pages 531-539, or equivalent.
Density	-(ASTM D-2937)

5.3 Soil Contaminant Characterization

~~5.3.1 SWMU Characterization (Phase II)~~

Phase I of the RFI workplan outlines methods to be taken to verify the existence of contamination resulting from the Solid Waste Management Units summarized in the RFA and the Post-Closure Permit. Data collected from Phase I and RFA soil samples collected from each SWMU will be compiled in order to

evaluate the need for further measures at each SWMU. ~~Included herein are proposed plans and procedures for sampling and analysis for Phase II sampling if contaminants exceed those values listed in Table 1.0 (Section 1.0).~~ At SWMUs where contaminant levels indicate a release has occurred in large enough quantity to have migrated beyond the boundaries of that particular SWMU and/or deeper than six inches, further investigation will take place. This will probably involve additional grid sampling beyond the unit boundary, and collection of borehole samples at depths to be determined specific to the unit and contaminants identified.

~~It is Lockwood's intention that the sampling and analysis activities during this phase of the RFI will define the nature, extent, and rate of migration of releases or potential releases of contaminants of concern from the designated SWMU's. The data and information collected from the RFA and Phase I will be used to direct further investigation regarding contaminant migration.~~

~~Soil samples will be collected at several discrete depths from the nodal points of a grid system at each SWMU where the Phase I investigation has revealed contaminants exist above action levels proposed by the EPA. Each SWMU of concern will have its own specific grid system which will depend upon the results of the Phase I screening. In general, each SWMU in which Phase II sampling is performed will have an adequate number of samples collected in order to define the extent and nature of contaminants found during the Phase I investigation. The exact spacing of the Phase II grid system and depths of sample collection will be determined based upon Phase I results.~~

~~Chemicals released to soils may undergo transformation or degradation by chemical or biological mechanisms. Please refer to Table 5.3 which summarizes those contaminant specific parameters which will be evaluated to address contaminant interaction/degradation/transformation.~~

5.4 Soil Sampling Protocol

Since spatial distribution of potential contaminants within all SWMU's in question is expected to be highly variable, a systematic sampling scheme will be developed to obtain representative samples within each SWMU. ~~A grid system on~~

~~AutoCAD will be developed and nodal sampling points selected for each SWMU of concern.~~ Samples will be collected and analyzed according to procedures outlined in Appendix C.

5.5 Sampling and Analysis Quality Assurance and Quality Control (QA/QC)

The purpose of the generation of data as a result of soil sampling and analysis in and adjacent to the solid waste management units during Phase II is to evaluate the following factors:

- ◆ Spatial distribution of contaminants in soils
- ◆ Extent to which the source can be adequately identified and characterized
- ◆ Likelihood of future releases if the substance remains on-site
- ◆ Extent to which natural or man-made barriers currently contain the substances and the adequacy of the barriers
- ◆ Extent to which the substances have migrated or are expected to migrate from their source and whether migration poses a threat to public health or the environment.

Data generated must be of a form necessary to make reliable and valid decisions regarding potential need for remedial response and/or corrective actions at the subject SWMU's. In order to conform to these criteria, data generated must be reliable, valid, precise, accurate, representative, complete, and comparable in order to facilitate the appropriate Quality in the form of Assurances and Controls.

A complete listing of QA/QC information including a description of QA objectives for measurement of data in terms of precision, accuracy, representativeness, completeness, and comparability can be found at Appendices C and D, Sampling and Analysis QA/QC Program.

PHASE II
SECTION 6.0
ITEM V.B.1.A.3.4.5
PLAN TO DETERMINE THE RATE
AND EXTENT OF CONTAMINATION IN GROUNDWATER

6.1 Introduction

The purpose of this plan is to propose methods and procedures to adequately investigate and determine the ~~amount~~ nature and extent of potential groundwater contamination resulting from ~~those SWMU's at Lockwood which have contaminants in the soil in excess of EPA MCL's and proposed action levels.~~ past actual or suspected releases of hazardous wastes from SWMUs at the Lockwood Corporation facility in Gering, Nebraska. The intent of this plan is to meet the requirements as outlined in Nebraska Department of Environmental Control (NDEC)/Environmental Protection Agency (EPA) Hazardous Waste Post Closure Permit for Post Closure Care, Lockwood Corporation Surface Impoundments, issued on September 29, 1989, and effective on October 30, 1989, Part V.B.1.a.3.

This section presents Lockwood's approach to investigating the amount and extent of groundwater contamination at Lockwood. The releases documented in the RCRA Facility Assessment (RFA) were localized (aerially) and, in part, consisted of highly volatile constituents. The existence of these conditions creates a situation where, if groundwater monitoring were to be based on exceedance of action levels in soil samples, significant areas of contamination would likely be missed due to a limited number of soil sampling sites or the migration of the hazardous constituents out of the vadose zone through volatilization. Therefore, groundwater monitoring at each SWMU will include the installation of monitoring wells as described in Section 6.2. ~~Information from the Phase I and Phase II soil studies will be used as a screening tool to define those SWMU's where monitoring wells are necessary. The concentration of any contaminants found from groundwater sampling will be combined with water level measurements to determine the velocity and extent of contamination.~~ The velocity of dissolved groundwater contaminants will be determined through the analysis of groundwater flow directions as determined using direct potentiometric data, combined with data obtained from properly conducted aquifer tests. Data will be plotted and

contoured on the enclosed site facility map (Sheet 1), and shown in cross-section. Further investigation may include the drilling and construction of additional permanent monitoring wells, and the collection of groundwater samples from the Brule Formation.

6.2 Monitoring Well Location and Number

Water table elevation data from November 1989 and regional water table data show the groundwater flow at Lockwood to be predominantly from southwest to northeast toward the Platte River. Monitoring wells for groundwater samples, therefore, will be located immediately down-gradient of each of the areas ~~identified in Phase I and Phase II as requiring further action.~~ SWMUs as depicted on Sheet 1. These four wells will be installed with well screens ten (10) feet in length, with the bottoms of the screens located at the top of the bedrock (Brule). In addition, another well will be installed to form a well couplet at the SWMU identified on Sheet 1 as the Used Oil and Empty Barrel Storage Area. This well will be installed so as to detect potential floating hydrocarbons, with a screen ten (10) feet in length, positioned so that the water table intersects the screen approximately at its midpoint.

Water samples from MW-8 shall be used to define background water quality. Irrigation return flows may cause seepage from canals and ditches located adjacent to the Lockwood facility, resulting in temporary seasonal variations in the groundwater flow directions. Quarterly water table elevations will be used to verify predominant groundwater flow direction prior to construction of wells.

~~In general, a monitoring well or monitoring well couplets shall be located on the downgradient side of each SWMU (Sheet 1) identified during Phase I and II soil sampling as having contaminants in the soil which are likely to affect groundwater. The decision as to the exact location and screened interval(s) of the wells will be based upon the physical/chemical characteristics of the contaminates found during the soil investigation and upon hydrogeologic factors.~~

~~If monitoring well couplets are necessary, they will be constructed in the same manner as the single wells, except that a shallow well and a deep well will be installed in each couplet. In general, shallow wells will be screened near~~

~~the top of the sand and gravel unit, deep wells will be screened near the base of the sand and gravel unit. Each well in a couplet will be installed in separate boreholes and spaced at least 10 feet apart.~~

Following installation and sampling of the initial downgradient monitoring wells, installation and sampling of additional wells will be proposed if any ~~samples exceed proposed EPA action levels or Federal MCL's for water (see Table 6.4).~~ groundwater samples indicate contaminant levels above method detection limits as described for selected contaminants in Section 6.3. The extent of contamination will be defined by groundwater samples reported as non-detect for the contaminants identified at the site. Additional wells will be situated so that the ~~rate~~ nature and extent of groundwater contaminants can be adequately assessed.

6.3 Sampling Protocol

Previous groundwater sampling near the closed waste pond has characterized the general groundwater quality at the facility. Groundwater sampling, therefore, will be done in order to determine if any contamination is present. A groundwater sample will be collected from each ~~existing MI or MW series of wells (Sheet 1) and analyzed for sulfate and nitrate.~~ of the following monitoring wells: The five (5) new wells to be installed for the RFI, and the following existing wells: MW-1, MW-4, MW-5, MW-8, LW-1, LW-2, and LW-4.

Groundwater samples from each of the above wells will be analyzed for the following contaminants:

- Volatile Organic Compounds
- Total Recoverable Petroleum Hydrocarbons
- Nitrate
- Sulfate
- Total Cyanide

The following metals, analyzed as "total recoverable," with no field-filtering:

- | | |
|------------|-------------|
| • Arsenic | • Lead |
| • Cadmium | • Manganese |
| • Chromium | • Nickel |
| • Copper | • Silver |
| • Iron | • Zinc |

Specific methods of analysis and method detection limits are given in Table 6.4 (revised, February 1992).

If additional wells are necessary, groundwater samples will be collected and analyzed for ~~EPA Method 8240 and Selected Total Metals (arsenic, cadmium, chromium, lead, silver, and zinc)~~. all contaminants identified during previous work. ~~Should a well be necessary in the Waste Oil Storage Area, analyses will also include oil and grease.~~ Specific Conductance and pH measurements will also be taken at each existing MI/MW or proposed new well.

~~A water level measurement will be taken from each existing and proposed well.~~ Water level measurements will be taken from all existing MW and LW -series wells, as well as the five new wells, to a precision of 0.01-foot. All water levels will be collected within a period of 24 hours. From these measurements and the well survey data, the elevation of the water table surface will be determined to a precision of 0.01-foot, and a water table surface contour map produced.

Groundwater samples will be collected from between 15 and 45 days after well development has been completed. Two complete rounds of groundwater sampling will be performed prior to preparation of the draft RFI Report. The two rounds of sampling will occur from between 30 and 60 days apart. Details of the sampling technique to be used when collecting samples and water level measurements are summarized in Appendix C.

For the new well which will be installed in the Used Oil and Empty Barrel Storage Area, and so constructed such that the water table intersects the well screen, a check for floating hydrocarbons will be made prior to purging. This will be accomplished using either an interface probe or a top-filling bailer. If a floating layer is determined to be present, its thickness will be determined and a sample collected for analysis.

6.4 Well Design

The artificial filter pack will be designed based on grain size data obtained from samples of the aquifer material collected from the pilot boring

~~TABLE 6.4~~~~Proposed EPA Action Levels for Groundwater~~~~EPA Method 8240~~

Compound	Detection Limits	Action Levels
Name	(ug/L)	(ug/L)
Chloromethane (listed for regs.)	10	*
Bromomethane (DWR)	10	50
Vinyl Chloride	10	2 (MCL)
Chloroethane (listed)	10	*
Ethanol	5000	*
Iodomethane	5	*
Methylene Chloride	5	5
Acetone	100	4000
Acrolein	100	*
Acrylonitrile	100	0.06
Carbon Disulfide	100	4000
Trichloromonofluoromethane	5	10000
1,1 - Dichloroethene	5	7 (MCL)
1,1 - Dichloroethane (listed)	5	*
Total - 1,2 - Dichloroethene	*	*
Chloroform	5	6
1,2 - Dichloroethane	5	5
2 - Butanone (MEK)	100	2000
Dibromomethane (listed)	5	*
1,1,1 - Trichloroethane	5	3000
Carbon Tetrachloride	5	300
Vinyl Acetate	50	*
Bromodichloromethane	5	300
1,2 - Dichloropropane (final)	5	*
1,3 - Dichloropropene	5	10
Trichloroethene	5	5 (MCL)
1,1,2 - Trichloroethane	5	6
Benzene	5	5 (MCL)
cis - 1,3 - Dichloropropene (listed)	*	*
2 - Chloroethylvinylether	10	*
Bromoform	5	700
1,2,3 - Trichloropropane	5	200
Total - 1,4 - Dichlorobutene	*	*
2 - Hexanone	50	*
4 - Methyl - 2 - Pentanone	50	2000
Tetrachloroethene	5	0.7
1,1,2,2 - Tetrachloroethane	5	2
Ethyl Methacrylate	5	*
Toluene	5	10000

~~EPA Method 8240~~

Compound	Detection Limits	Action Levels
Name	(ug/L)	(ug/L)
Chlorobenzene	5	700
Ethylbenzene	5	4000
Styrene	5	7000
Total Xylenes	*	70000
Dichlorodifluoromethane	*	7000
Napthalene	*	*
2-Methylnaphthalene	*	*

~~Total Metals~~

Metal	Detection Limits	Action Levels
	(mg/L)	(mg/L)
Arsenic	0.005	0.05
Cadmium	0.005	0.01
Chromium VI	0.005	0.05
Lead	0.005	0.05
Silver	0.01	0.05
Zinc	0.01	*

(MCL) - Maximum Contaminant Level

* - Data not available

TABLE 6.4
RFI GROUNDWATER PARAMETERS
LOCKWOOD CORPORATION

Contaminant	Method (SW-846)	Detection Limit ($\mu\text{g/L}$)
Volatile Organic Compounds	8240	5-100
Nitrate	9200	40
Sulfate	9035	2000
Total Cyanide	9010	4
Contaminant	Methods for Chemical Analysis of Water and Wastes EPA-600/4-79-020	Detection Limit ($\mu\text{g/L}$)
Total Recoverable Petroleum Hydrocarbons	418.1	1000
Metals	Method (SW-846)	Detection Limit ($\mu\text{g/L}$)
Arsenic	7060	1.0
Cadmium	7131	0.1
Chromium	7191	1.0
Copper	6010	6.0
Lead	7421	1.0
Nickel	6010	15.0
Silver	7760	10.0
Zinc	7950	5.0
Iron	6010	7.0
Manganese	6010	2.0

drilled during Phase I (see Section 3.0). Standard industry practices will be used during well design, such as those described in the "Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells" (EPA/600/4-89/034, March 1991). Screen slot size will be selected so that at least 90% of the artificial filter pack will be retained.

~~6.4 Well Construction~~

6.5 Well Drilling and Construction

~~If wells are necessary, they~~ Wells will be constructed using 2-inch, threaded, Schedule 40, machine slotted PVC screen, and Schedule 40, 2-inch, threaded, PVC casing, and a ~~2-foot PVC sump~~ standard 0.5-foot bottom cap. Casing will extend approximately 2 feet above grade.

During the drilling of each new monitoring well, except the shallow well to be installed in the Used Oil and Empty Barrel Storage Area, continuous sampling and detailed logging will be performed as described in Section 3.2. The boring log from the deep well to be installed in the Used Oil and Empty Barrel Storage Area will suffice for the shallow well, since they will comprise a well couplet and will be located approximately ten feet apart; the deep well will be installed first so that the log may be used to guide the drilling and installation of the shallow well.

Filter pack material (Colorado Silica Sand, Inc. or approved alternative) consisting of clean, inert, uniform sand shall be installed in the annulus to ~~one~~ two feet above the top of the screen using a tremie pipe. Monitoring well filter pack and screen slot size will be selected based on the results of the proposed grain size testing (Section 3.3). An annular sealant consisting of bentonite pellets shall be installed to a depth of 2 feet above the top of the sand. All bentonite seals will be allowed to hydrate for a minimum of eight (8) hours prior to grout placement. Grout shall extend from the top of the bentonite seal to 3 feet below grade and shall be ~~installed using a tremie~~ placed using a tremie pipe equipped with a side-discharge or a deflector to prevent erosion of the bentonite seal during placement. Grout shall consist of a mixture of 8 2-6 percent by weight bentonite and portland type ~~concrete~~ cement. A well cover with locking cap shall extend from 3 feet below grade to 2 feet above grade and be set in

concrete which shall extend from the top of the bentonite to grade. The concrete shall extend three feet from the well in order to form a well apron. All downhole well construction shall be done using a hollow stem auger. All PVC pipe shall be washed with a high pressure, hot wash before being installed in the well.

Lengths of well screen and riser shall be joined without the use of solvents. At least two centralizers shall be used in each well. Since the bentonite seal may be located above the saturated zone, bentonite pellets shall be hydrated by adequately wetting with clean water before grout or concrete is poured into the annulus. All bentonite pellet seals will be allowed to hydrate for a minimum of eight (8) hours prior to grout placement. The final design of the monitoring wells, insofar as screen length, placement, and location is concerned, will be determined after logging and sampling the borehole. In general, wells will be designed according to industry standards so as to adequately define any groundwater contamination at Lockwood.

For wells the shallow well placed downgradient of the Oil Storage Area, the well will be designed so the surface of the water table will intersect the screen at the midpoint; this will ensure the capability to detect and sample light non-aqueous phase liquids if present. Screen length and placement can be determined through analysis of historic water table elevation data, with the mid-point of the well screen positioned at the level representing the average water table elevation. Screen length can be determined by analyzing seasonal water table fluctuations, and will be of sufficient length so as to account for these fluctuations, thus assuring the ability of the well to yield samples from the top of the water table throughout the year.

For wells in which the bentonite seal will be located above the saturated zone, such as ~~the wells~~ the shallow well monitoring the Oil Storage Area, an effective seal will be constructed by placing granular (not powdered) bentonite in half-foot thick layers, hydrating with several gallons of water between each layer until a two to three-foot seal is constructed (1/4-inch pellets may be used if granular bentonite is unavailable). Obtaining an adequate bentonite seal is important in order to reduce the likelihood of grout contamination.

~~The most important factor in determining sufficient well development is turbidity. Stabilization of pH, conductivity, and temperature, to within 10% between successive well volumes will be used in determining whether sufficient groundwater has been removed from a well during purging prior to sample collection. Monitoring wells will be developed until they produce water of acceptable turbidity. If water has been added during well installation, such as when mud rotary drilling is used, then stabilization of pH, conductivity, and temperature can be used to help demonstrate removal of this water after the wells have been developed with respect to turbidity.~~

~~During well development, pumping results in unidirectional flow into the well. Particles of the unconsolidated aquifer can "bridge" over pore spaces, rather than pack within the spaces; the bridging is created by the force of the flowing water. The purpose of surging the wells with a surge block is to induce flow reversal which will break down the bridged particles. When pumping resumes after surging, the particles will sort and lodge in the pore spaces, creating a more tightly packed, stable and effective filter. An increase in the amount of fines will be caused by redistribution of the particles; in a properly designed well the amount of turbidity observed after each initial start of a pumping cycle will decrease as development continues. Well development will involve several alternating cycles of pumping and surging; the well will be considered developed when the groundwater produced shortly after starting the pump is of acceptable turbidity.~~

~~Monitoring wells shall be developed by surging and over pumping. Well development will continue until pH, conductivity, and temperature have stabilized to within a range of $\pm 10\%$ between successive well volumes and when turbidity has decreased to a value of 5 N.T.U.s or less. Over pumping will be done using a "Westinghouse" arc well development pump.~~

~~Surging will be accomplished using a surge block designed for 2 inch monitoring wells. The surge block consists of a stainless steel pipe with attached stainless steel disc and rubber rings. The wells will be surged to loosen formation material then pumped until the loose material is evacuated from the well and the formation water parameters have stabilized, as described above. Wastewater from well development will be stored in a sealed container located at~~

~~the well until chemical analyses is completed; at which time a proper disposal method can be utilized.~~

After completion of well installation, all wells will be surveyed by a licensed surveyor for 1) elevation to top of casing, 2) elevation of grade, and 3) location. Tolerances for surveyed elevations will be determined to within 0.01-foot, and surveyed locations to within 0.5-foot.

All information on well construction shall be documented on well construction forms (Appendix C).

6.6 Well Development

Monitoring well development will be accomplished through alternating cycles of over-pumping and surging. Over-pumping will be accomplished using a portable centrifugal pump, since the shallow depth to water at the site is well within the limits for suction-lift pumping. The pump will be of the type capable of pumping fluids containing solids ("trash" pump) so that it may remove fines drawn into the well during development.

All fluids removed during development will be containerized and stored in a sealed container. Proper disposal of the development fluids will be determined through evaluation of chemical data from either samples of the development fluid itself, or from groundwater samples obtained from the well during the RFI.

Surging will be accomplished using a surge block designed for 2-inch monitoring wells. The surge block will consist of a stainless steel pipe with attached stainless steel disc and flexible rings composed of an inert material. Due to the fragile nature of the wells, the surge block will be slightly less in diameter than the inside diameter of the well, and the surging action will be gentle. During surging, the location of the surge block within the well will be carefully measured and monitored to avoid the possibility of damaging the well by striking the bottom of the well with the surge block.

Well development will involve several alternating cycles of over-pumping and surging. Well development will be considered completed when the water

produced shortly after a pumping cycle is initiated is of acceptable turbidity, as determined using a portable turbidity meter.

Turbidity of water removed from the wells during development will be measured using a properly calibrated field nephelometer (turbidity meter) reading out in nephelometric turbidity units (NTUs). A goal of less than five (5) NTUs will be used; however, in some cases this level cannot be achieved due to the nature of the formation within which the well is screened. In this case, an alternate turbidity standard will be proposed during the fieldwork.

During monitoring well drilling and installation, water from an approved source may need to be added to the borehole for such purposes as equalizing hydraulic head within hollow-stem augers to prevent "heaving" sands, during placement of the artificial filter pack using a tremie, and when mud rotary drilling is used. In such cases where water has been added, an additional development standard will be used to demonstrate removal of the added water once the turbidity standard has been achieved. This additional standard will be the stabilization of successive temperature, pH, and conductivity readings to within 10% during the removal of two successive well volumes of water.

6.7 Evaluation of Existing Wells for Re-Development

As stated in Section 6.3, the following existing monitoring wells will be sampled during the RFI: MW-1, MW-4, MW-5, MW-8, LW-1, LW-2, and LW-4. Prior to groundwater sampling for the RFI, water samples will be collected from these existing wells and evaluated for turbidity using the field nephelometer, and the turbidity standard used for the new wells. If groundwater from the existing wells does not meet the turbidity standard, the wells will be re-developed using the same procedures outlined in Section 6.6.

PHASE II
SECTION 7.0
ITEM V.B.1.c.

SURFACE WATER RUN-OFF AND SEDIMENT CHARACTERIZATION PLAN

7.1 Introduction

The purpose of this plan is to investigate the nature and extent of potential contaminant movement via surface water run-off and sediment pathways at those SWMU's where Phase I and II soil sampling results show contaminants above EPA proposed action levels. It is Lockwood's intention that the subject surface water run-off and sediment characterization plan will adequately address all concerns outlined in the Nebraska Department of Environmental Control (NDEC)/U.S. Environmental Protection Agency (EPA) Post Closure Permit for Lockwood Corporation Closed Waste Acid Lagoons, issued September 29, 1989, and effective October 29, 1989. This plan summarizes the activities proposed to further investigate the potential for ~~surface water and sediment~~ contamination as outlined above.

7.2 Surface Water Run-off

During the sampling phase of the Versar, Inc. RFA, it was suggested that a potential existed for contamination of surrounding areas via surface water run-off and through potential sediment carriers. The facility slopes slightly toward the south, with the lowest point located at the southeast corner of the site (Sheet 1). Two exterior drainage ditches located along the south edge of the property (Gering drain tributary) and east edge of the property (Barrow pit) are the receptors for any surface water run-off from the facility. Three storm drainage ditches located inside the property boundaries are designed primarily to divert water which originates from rooftop or parking areas into the exterior drainage ditches. During extreme precipitation events the Gering drain tributary and Barrow pit ditch may have standing or low flow water. Irrigation return flow from adjacent fields may cause some continuous flow to occur in the Gering drain tributary during late summer months. The ditches are otherwise dry during the

year. The Gering ditch is generally covered with grass, while storm drains are sand or gravel covered.

~~Due to the limited amount of precipitation in the Scottsbluff area (Average annual precipitation - 14.59 inches, National Weather Bureau, Scottsbluff Airport), the relatively high evaporation rates, the highly permeable nature of topsoil (silty, clayey sands and gravel), and the over all flat surface terrain (low surface gradient), it is Lockwood's opinion that; 1) surface water run off from SWMU's would occur only during brief, isolated, heavy thunderstorm events, and 2) the potential for adverse environmental impact via surface water run off is low.~~

7.3 Methods of Investigation

~~Periodic monitoring of surface water flow near possible point sources (SWMU's) is the most effective method of identifying the occurrence of possible releases via surface water. Lockwood proposes to initially collect sediment and water samples from the ditches and drains adjacent to the point source areas to assess the impact of any surface water run off. Collection of surface water samples will be done immediately following a precipitation event large enough to produce flowing or standing water in the exterior ditches and drains. Sediment samples will also be initially collected from storm ditches following a storm event. Sediment samples will be collected from the ditches near potential point sources following a precipitation event.~~

For a complete description of QA/QC procedures for soil and water characterization and analyses please refer to Appendix D. In general, sediment samples for surface water characterization will be collected at the surface using a steel trowel and analyzed for volatile organic compounds (EPA Method 8240) and Selected Total Metals (arsenic, cadmium, chromium, lead, silver, and zinc).

~~Surface water samples will be collected from the ditches using a depth integrated open mouth weighted bottle, at the center of channel flow and analyzed for EPA Method 8240 and Selected Total Metals. An open mouth bottle sampler will be used at varying points along the water column from the surface to the bed in order to allow for a more representative sample. Flow rate will~~

~~be measured at each sampling site using a pygmy flow meter.~~

~~The following presents the initial surface water and sediment monitoring plan to be used for each SWMU in which Phase I and II soil sampling results exceed EPA action levels.~~

~~7.3.1 Hazardous Waste Storage Area~~

~~Surface water run off from this area drains to the storm drainage ditch to the west and eventually to the Gering tributary drain ditch. Lockwood proposes collecting simultaneous surface water samples 1) adjacent to this SWMU, 2) from the drainage ditch "upstream" near the roof runoff source area, 3) from the Gering ditch near the southwest corner of the facility, 4) from the Gering drain at the mouth of the drainage ditch, and 5) from the Gering ditch near the southeast corner of the facility. Flow will also be measured at each surface water sampling point.~~

~~Two Sediment samples will be collected from the drainage ditch and the barrow pit. Visual observations of sediment accumulation, if any, in the ditches and drains in this area will be used to identify areas where sediment collection is occurring. If no sediment accumulation is observed in the ditches or drains following a precipitation event, sediments will be collected from those areas observed to be "low lying" areas where surface water is most likely to be in contact with the drainage ditches for the longest period of time.~~

~~7.3.2 Raw Product Storage Area~~

~~The raw product storage area is sited on a concrete pad approximately 30 ft. x 35 ft. in size. This area is sloped slightly to the south and during a heavy rainfall event would drain surface water into the western most storm drainage ditch which feeds the Gering drain tributary. Lockwood proposes collecting simultaneous surface water samples 1) adjacent to this SWMU in the drainage ditch, 2) from the drainage ditch "upstream" near the roof runoff source area, 3) from the Gering Ditch near the southwest corner of the facility, and 4) from the Gering ditch "upstream" or west of the facility. Flow will also be measured at each surface water sampling point.~~

~~Two Sediment samples will be collected from the drainage ditch and the Gering Drain. Visual observations of sediment accumulation, if any, in the ditches and drains in this area will be used to identify areas where sediment collecting is taking place. If no sediment accumulation is observed in the ditches or drains following a precipitation event, sediments will be collected from those area's observed to be "low lying" areas where surface water is most likely to be in contact with the drainage ditches for the longest period of time.~~

~~7.3.3 Scrap Metal Area~~

~~Surface water from this area would drain to the drainage ditch to the east and eventually into Gering Drain to the south. Lockwood proposes collecting surface water samples from 1) the mouth of the adjacent storm drainage ditch and the borrow pit ditch, 2) from the borrow pit ditch "upstream" of the mouth of the storm water drain, and 3) from the borrow pit ditch "downstream" of the mouth of the storm drainage ditch.~~

~~Two sediment samples will be collected from the drainage ditch and the Gering Drain. Visual observations of sediment accumulation, if any, in the ditches and drains in this area will be used to identify areas where sediment collection is taking place. If no sediment accumulation is observed in the ditches or drains following a precipitation event, sediments will be collected from those area's observed to be "low lying" areas where surface water is most likely to be in contact with the drainage ditches for the longest period of time.~~

~~7.4 Further Characterization~~

~~Based upon the results of the samples collected at or near each potential point source, more intensive sampling may be required. If the initial point source sampling shows contaminants are present in surface water or sediments above EPA action levels (Table 1.0 and 6.4), the following parameters will be established:~~

- ~~1. Further monitoring locations.~~
- ~~2. Area flow conditions.~~
- ~~3. Fate and extent of contaminants.~~

~~The above criteria will be established by defining the physical attributes of the wastes and the drainage system. Definition of physical attributes will include waste characterization, drainage area characterization, infiltration and rainfall/runoff measurements, channel characterization, and background contaminant levels.~~

~~Characterization of the fate and extent of contaminants in surface water runoff beyond the immediate area of the Lockwood facility (i.e., drainage ditches, Gering Drain) could involve collection of surface water, biota, and sediment samples in the Gering Drain from Lockwood to the Platte River. Not enough information is available at this time to plan such an extensive surface water runoff sampling plan. Should such a plan be necessary it could involve biomonitoring, hydrologic monitoring such as periodic or permanent flow measurements in the Gering drain, and statistical evaluation of data. Should contaminants be found leaving the area of the facility, a more extensive surface water runoff monitoring plan will be submitted.~~

~~Surface Water Sampling Summary~~

Samples	TCLP2 Total	Metals	3	EPA Method	Metals	EPA Method	Locations	No.	of
				6244		82405			

Hazardous Waste (soil)	1	X	X
Raw Product (soil)	1	X	X
Barrow Pit (water)	2	X	X
Gering Drain (soil)	1	X	X
Gering Drain (water)	2	X	X

~~1One sample is a field duplicate.~~

~~2TCLP Metals: arsenic, cadmium, chromium, lead, silver, and zinc.~~

~~3Total Metals: arsenic, cadmium, chromium, lead, mercury, silver, and zinc; on unfiltered samples.~~

~~4Method 624 parameters: See Appendix C 6.~~

~~5Method 8240 parameters: See Appendix D 1.~~

PHASE II
SECTION 8.0
SAMPLE ANALYSIS REPORT AND
SCHEDULE OF IMPLEMENTATION (PHASE II)

8.1 Report

A report of field activities will be submitted to the Nebraska Department of Environmental Control and EPA Region VII. The report will include 1) a copy of the laboratories report of findings including the quantity of each of the parameters assessed in the analysis and the detection level for that particular analysis, 2) a copy of a field sampling survey form which provides information on field parameters measured, purged volume and rates, depth to groundwater, and comments relevant to the sample collection, and 3) a site map showing sample locations. Data will be presented in tabulated form.

8.2 Schedule for Implementation (Phase II)

8.2.1 *Soils and Sediment*

For each SWMU in which Phase II soil and sediment sampling is required a Phase II sampling grid and characterization plan will be submitted within 45 days after Phase I sampling ~~is initiated~~ results are received. Phase II soil and sediment characterization and sampling will be initiated within 30 days following EPA approval of the Phase II sampling scheme.

Phase II soil and sediment characterization and sampling results will be completed and reported to the EPA within 60 days following initiation of Phase II field activities.

~~8.3.2~~ Groundwater

8.2.2

Installation of monitoring wells will be initiated ~~at each SWMU where groundwater is likely to be impacted within 90 days following initiation of Phase~~

~~II soil sampling.~~ within 45 days following completion of grain size analysis of samples obtained from the pilot hole required in Phase I.

Results of groundwater analyses will be completed and forwarded to the EPA within 45 15 days following ~~initiation of well installation~~ Lockwood's receipt of laboratory findings.

~~8.3.3 Surface Water and Sediment~~

~~Surface water and sediment sampling will be initiated at the first rainfall event large enough to produce run off following submittal of Phase II soil sampling results.~~

**APPENDIX A
BORING LOGS AND
WELL CONSTRUCTION DETAILS
FOR MW WELLS**



Hoskins • Western • Sonderegger, Inc.
P.O. Box 80358 3231 Street
Lincoln, Nebraska 68501
402/475-4241

March 19, 1986

Lockwood Corporation
Highway 92 East
Gering, Nebraska 69341

Attention: Mr. Roy Dugan

Reference: Groundwater Monitoring/
Spent Acid Evaporation Ponds

Dear Sir:

This letter and its attachment is forwarded as an update on the status of groundwater conditions at the spent acid evaporation ponds. It is also intended as a response to requests made in the Nebraska Department of Environmental Controls (NDEC) October 3, 1985, letter (Exhibit I).

The attachment is a packet of the drilling logs, the as-built plans of monitoring wells, a site plan and a spread sheet of groundwater quality at monitoring sites. The packet should be kept as a permanent record, monthly/quarterly data can be added as needed.

Summary of Events

Eight monitoring wells and two monitoring/interceptor wells were installed by Nelson Wells, Inc., between October 7 and October 10, 1985. Inspection and collection of drilling samples was performed by Don Kuhlman of HWS. The packet includes drillers logs provided by Nelson and description logs of the samples provided by HWS. The depths shown on the drillers logs refer to changes in material detected by the drilling action. The depths shown on the description logs refer to the intervals from which the samples were recovered. The drillers logs refer to gravel detected by the action of the bit which did not appear in the samples because the bit probably ground the gravel particles into sand.

The drilling was performed by the direct rotary method using water as the circulating fluid. The ten completed wells were developed by pumping drilling fluids and fines with a submersible pump. Well yields ranged from 5 to 35 gallons per minute.

The monitoring wells were sampled under chain-of-custody documentation according to NDEC standards on November 7, 8, and 9, 1985. A second sampling was performed on February 25, 1986.

WESTERN LABORATORIES Materials Engineers 325 J Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska <div style="text-align: right;">84/3936.03</div>			
BORING LOG							
Boring Method Rotary w/ circulation water		Standard Penetration Test		Boring No. 11-1			
Undisturbed Soil Sampler: 3-in. o.d. thin-walled tube		140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 1 of 2		
w = Moisture Content, % D = Dry Density, pcf		Penetration Resistance: N = Blows per foot		Date: 10-9-65			

Elevation	Depth J	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3878		CL	Silty clay, 10% fine sand, dark brown, moist, low plasticity			
	3	CL	Silty clay, same as above, 30% fine to coarse sand, dark brown.			
	5					
	6	SP	Sand, fine to coarse, 5% fines brown			
	10					
	15					
	17	SM	Silty Sand, fine to medium, 15% fines, brown			
	19	SP	Sand, fine to coarse, 5% fines, brown.			
	20					

Water Level at 9.4'
 on 2-25-36

WESTERN LABORATORIES Materials Engineers 825 "J" Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska			
BORING LOG				84/3936.03			
Boring Method Rotary w/ circulation water			Standard Penetration Test			Boring No. M-2	
Undisturbed Soil Sampler. 3-in. od. thin-walled tube			140-lb. Hammer	30-in. Fall	2-in. od. Split-barrel Sampler	Sheet 1 of 2	
w = Moisture Content, % D = Dry Density, pcf			Penetration Resistance: N = Blows per foot			Date 10-10-85	

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3878	0	CL	Silty clay, 10% fine sands, brown, low plasticity.			
	5					
	6	CL	Silty clay, 45% fine to medium sands, brown, low plasticity.			
	10	SM	Sand, fine to coarse, grey, 13% fines, 10% brown fine gravels.			
	15					
	20					

Water Level at 9.2'
 on 2-25-86

WESTERN LABORATORIES Materials Engineers 925 1st Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska			
BORING LOG				84/3936.08			
Boring Method Rotary w/ circulation water		Standard Penetration Test			Boring No. M-2		
Undisturbed Soil Sampler: 3-in. o.d. thin-walled tube		140-lb Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 2 of 2		
w = Moisture Content, %	D = Dry Density, pcf	Penetration Resistance: N = Blows per foot			Date: 10-10-85		

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3858	20	SP	Sand, medium to coarse, grey, 5% fines, 20% fine gravels.			
3863	24	CL	(Bruie Formation)			
	25					
	27					

WESTERN LABORATORIES Materials Engineers 825 W. Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska 34/3936.03			
BORING LOG							
Boring Method Rotary w/ circulation water		Standard Penetration Test			Boring No. M-3		
Undisturbed Soil Sampler: 3-in. o.d. thin-walled tube		140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 1 of 2		
w = Moisture Content, % D = Dry Density, pcf		Penetration Resistance: N = Blows per foot			Date: 10-10-35		

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3879	0	CL	Silty clay, 20% fine sands, dark brown, low plasticity.			
	5					
	9	SP	Sand, fine to coarse, 5% fines, gray, 5% fine gravels			
	10					Water Level at 9.9' on 2-25-36
	15					
	20					

WESTERN LABORATORIES Materials Engineers 625 11 th Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska			
BORING LOG				84/3936.03			
Boring Method Rotary w/ circulation water			Standard Penetration Test			Boring No. M-3	
Undisturbed Soil Sampler, 3-in. od. thin-walled tube		140-lb. Hammer	30-in. Fall	2-in. od. Split-barrel Sampler		Shear 2 of 2	
w = Moisture Content, % D = Dry Density, pcf		Penetration Resistance, N = Blows per foot			Date 10-10-85		

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3859	20	SP	Sand, same as above.			
3855	24	CL	(Bruie Formation)			
	25					
	27					

WESTERN LABORATORIES Materials Engineers 825 "J" Street - Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska			
BORING LOG				84/3936.03			
Boring Method Rotary w/ circulation water		Standard Penetration Test			Boring No M-1		
Undisturbed Soil Sampler: 3-in. o.d. thin-walled tube		140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler		Sheet 1 of 2	
w = Moisture Content, % D = Dry Density, pcf		Penetration Resistance: No Blows per foot				Date 10-9-35	

Elevation	Depth	Group Symbol	Description of Materials	Sampler No.	Blows	Remarks
3879	0	CL	Silty sand, 15% fine sand, dark brown, low plasticity.			
	5					
	8	SC	Clayey sand, 40% fines, fine to coarse sand, brown, slight plasticity.			
	10					
	12	SM	Silty sand, 15% fines, fine to coarse sand, brown.			
	14					
	15	SP	Sand, fine to coarse, 5% fines, brown.			
	20					

Water Level at 10.3'
 on 2-25-36

WESTERN LABORATORIES Materials Engineers 825 W. Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska			
BORING LOG				84/3936.08			
Boring Method Rotary w/ circulation water		Standard Penetration Test			Boring No. M-5		
Undisturbed Soil Sampler: 3-in. od. thin-walled tube		140-lb. Hammer	30-in. Fall	2-in. od. Split-barrel Sampler		Sheet 1 of 2	
w=Moisture Content, % D=Dry Density, pcf		Penetration Resistance: No. Blows per foot			Date 10-9-85		

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3879	0	CL	Silty clay, 15% fine sand, dark brown, low plasticity.			
	5					
	7	SM	Silty sand, fine to medium, 15% fines, grayish brown.			
	10					
	12	SM	Silty sand, fine to medium, 65% medium sand, 15% fines, grayish brown.			Water Level at 11.1' on 2-25-86
	15					
	20					

WESTERN LABORATORIES Materials Engineers 825 1 st Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska			
BORING LOG				84/3936.03			
Boring Method: Rotary w/ circulation water			Standard Penetration Test			Boring No. M-5	
Undisturbed Soil Sampler: 3-in. od. thin-walled tube			140-lb. Hammer	30-in. Fall	2-in. od. Split-barrel Sampler	Sheet 2 of 2	
w=Moisture Content, %		D=Dry Density, pcf	Penetration Resistance: N=Blows per foot			Date: 10-9-85	

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3859	20	SM	Same as above.			
	24		(Brule Formation)			
3855	25					
	30					

WESTERN LABORATORIES Materials Engineers 825 17 th Street Lincoln, Nebraska	PROJECT Lockwood Corp. Gering, Nebraska
BORING LOG	

84/3936.08

Boring Method Rotary w/ circulation water	Standard Penetration Test	Boring No M-6
Undisturbed Soil Sampler: 3-in. o.d. thin-walled tube	140-lb. Hammer 30-in. Fall	2-in. o.d. Split-barrel Sampler
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot	Date 10-7-85

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3879	0	SM	Silty sand, fine to medium, 35% fines, grayish brown, slight plasticity.			
	3	SP	Sand, fine to coarse, 5% fines, 5% fine gravels, grayish brown.			
	5					
	10					
	15					
	20					

Water Level at 9.1'
on 2-26-86

WESTERN LABORATORIES

Materials Engineers

825 1st Street

Lincoln, Nebraska

BORING LOG

PROJECT

Lockwood Corp.
Gering, Nebraska

34/3936.08

Boring Method Rotary w/ circulation water	Standard Penetration Test			Boring No. M-6
Undisturbed Soil Sampler: 3-in. o.d. thin-walled tube	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 2 of 2
w=Moisture Content, %	D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 10-7-85

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3859	20	SP	Same as above.			
	25					
3849	30	CL	(Brule Formation)			
	35					

WESTERN LABORATORIES Materials Engineers 825 L Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska			
BORING LOG				84/3936.03			
Boring Method Rotary w/ circulation water		Standard Penetration Test			Boring No M-7		
Undisturbed Soil Sampler: 3-in. o.d. thin-walled tube		140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler		Sheet 1 of 2	
w = Moisture Content, % D = Dry Density, pcf		Penetration Resistance: N = Blows per foot			Date 10-8-85		

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3879	0	CL	Silty clay, 15% fine sand, dark brown, low plasticity.			
	4	ML	Sandy and clayey silt, 35% fine sand, yellowish brown, slight plasticity.			
	9	SM	Silty sand, fine to medium, 25% fines, brown.			
	10	SM SP	Silty sand, medium to coarse, 65% medium sands, 10% fines, brown.			
	13					Water Level at 10.2' on 2-25-86
	15					
	20					

WESTERN LABORATORIES Materials Engineers 825 11 th Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska			
BORING LOG				84/3936.03			
Boring Method Rotary w/ circulation water			Standard Penetration Test			Boring No. M-7	
Undisturbed Soil Sampler: 3-in. o.d. thin-walled tube			140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 2 of 2	
w = Moisture Content, %		D = Dry Density, pcf		Penetration Resistance: N = Blows per foot		Date 10-8-65	

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3859	20	SM SP	Same as above.			
3855	24	CL	(Bruie Formation)			
	25					
	30					

WESTERN LABORATORIES Materials Engineers 825 N. Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska			
BORING LOG				34/3936.03			
Boring Method Rotary w/ circulation water		Standard Penetration Test		Boring No. M-8			
Undisturbed Soil Sampler: 3-in. od. thin-walled tube		140-lb Hammer	30-in Fall	2-in. od. Split-barrel Sampler	Sheet 1 of 2		
w=Moisture Content, % D=Dry Density, pcf		Penetration Resistance: No Blows per foot		Date 10-10-85			

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3879	0	CL	Silty clay, 15% fine sand, dark brown, low plasticity.			
	5	SM	Silty sand, fine to coarse, 30% fines, dark brown.			
	10					
	15	SM	Silty sand, fine to coarse, 20% fines, 20% fine gravel, brown.			
	20					

Water Level at 9.7'
on 2-25-86

WESTERN LABORATORIES Materials Engineers 825 W. Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska			
BORING LOG				84/3936.03			
Boring Method Rotary w/ circulation water			Standard Penetration Test			Boring No. M-8	
Undisturbed Soil Sampler: 3-in. o.d. thin-walled tube			140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 2 of 2	
w=Moisture Content, % D=Dry Density, pcf			Penetration Resistance: N=Blows per foot			Date: 10-10-85	

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3859	20	SM	Same as above.			
3854	25	CL	(Brule Formation)			
	27					

WESTERN LABORATORIES Materials Engineers 825 17 th Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska <div style="text-align: right;">34/3936.03</div>			
BORING LOG							
Boring Method Rotary w/ circulation water			Standard Penetration Test			Boring No. MI-1	
Undisturbed Soil Sampler: 3-in. od. thin-walled tube			140-lb. Hammer	30-in. Fall	2-in. od. Split-barrel Sampler	Sheet 1 of 2	
w = Moisture Content, % D = Dry Density, pcf.			Penetration Resistance: N = Blows per foot			Date 10-9-65	

Elevation	Depth	Group Symbol	Description of Materials	Sampler No.	Blows	Remarks
3879	0	CL	Silty clay, 15% fine sands, dark brown, low plasticity.			
	5	SM	Silty sand, fine to medium, 20% fines, grayish brown.			
	14	SP	Sand, fine to coarse, 5% fines, 10% fine gravels, grayish brown.			
	15					
	20					

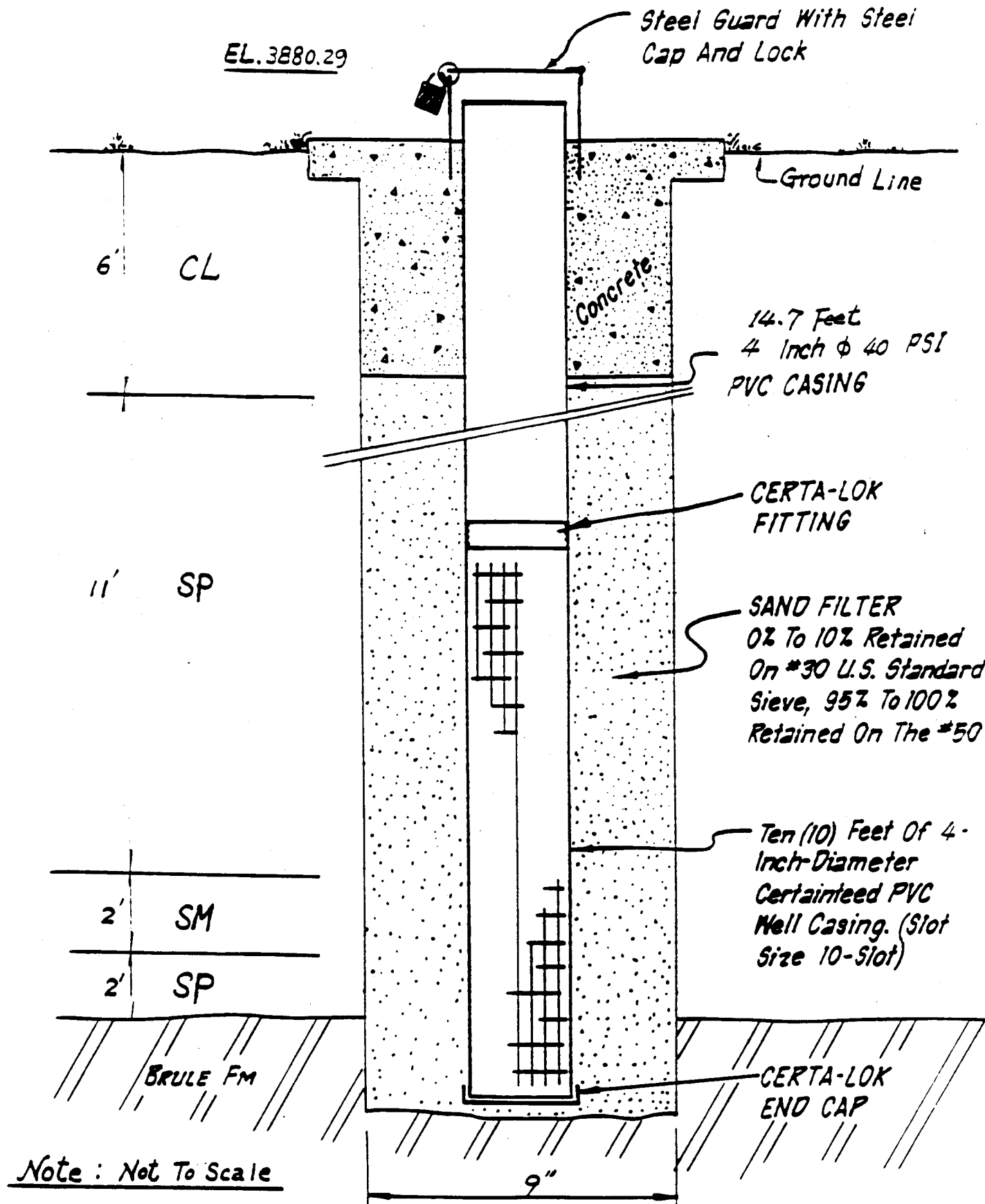
WESTERN LABORATORIES Materials Engineers 825 G Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska			
BORING LOG				84/3936.03			
Boring Method Rotary w/ circulation water			Standard Penetration Test			Boring No MI-1	
Undisturbed Soil Sampler: 3-in. o.d. thin-walled tube			40-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 2 of 2	
w = Moisture Content, % D = Dry Density, pcf			Penetration Resistance: N = Blows per foot			Date 10-9-85	

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3859	20	SP	Same as above.			
3854	25	CL	(Brule Formation)			
	27					

WESTERN LABORATORIES Materials Engineers 825 3 rd Street Lincoln, Nebraska				PROJECT Lockwood Corp. Gering, Nebraska			
BORING LOG				84/3936.03			
Boring Method Rotary w/ circulation water		Standard Penetration Test			Boring No MI-2		
Undisturbed Soil Sampler: 3-in. od. thin-walled tube		140-lb. Hammer	30-in. Fall	2-in. od. Split-barrel Sampler		Sheet 1 of 2	
w=Moisture Content, % D=Dry Density, pcf		Penetration Resistance: N=Blows per foot			Date: 10-7-35		

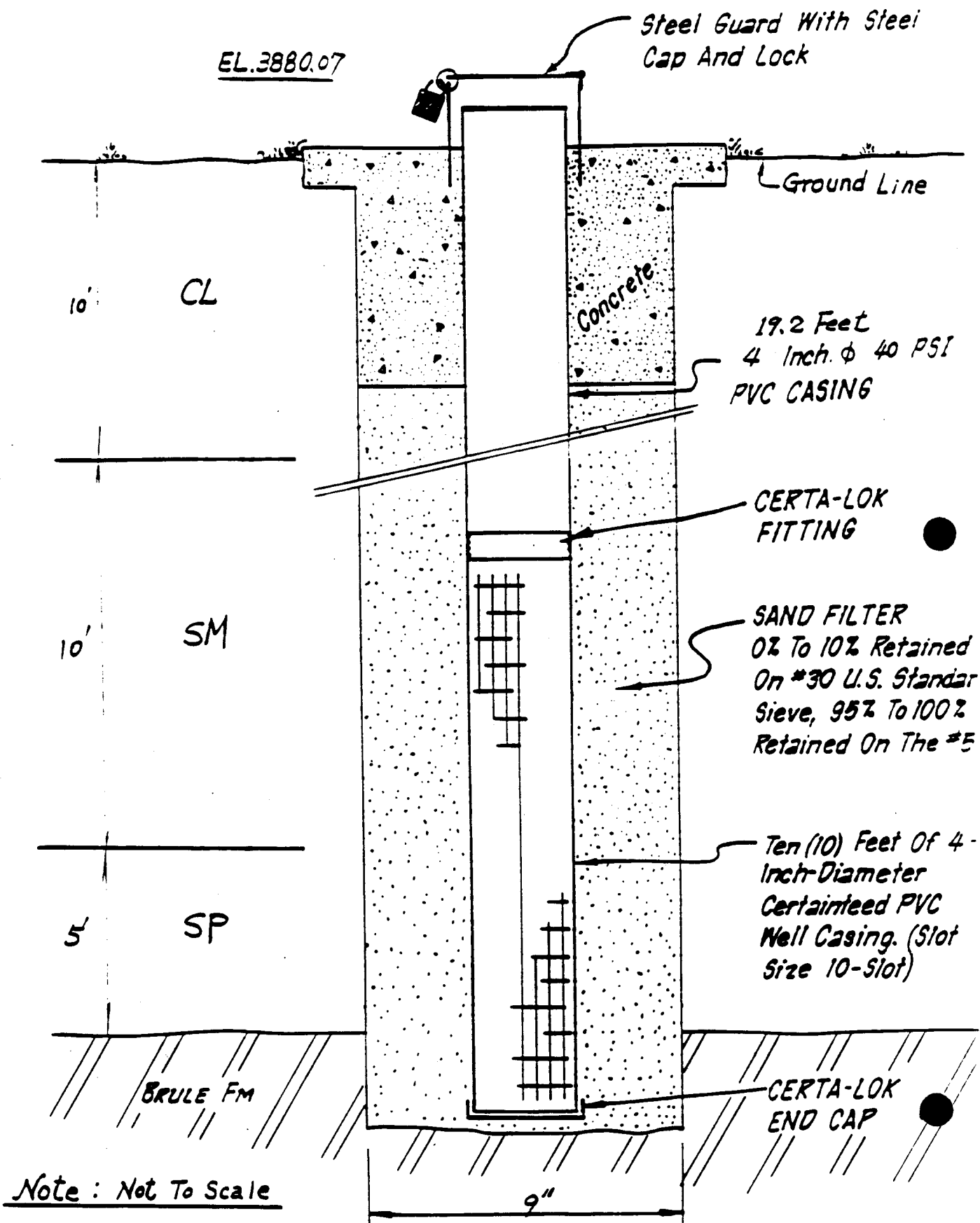
Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
3878	0	CL	Silty clay, 15% fine sands, dark brown, low plasticity.			
	3	SM	Silty sand, fine to medium, 35% fines, light brown.			
	9	SP	Sand, fine to coarse, 10% fine gravel, 5% fines, grayish brown.			
	13	SM	Silty sand, fine to medium, 20% fines, light brown.			

FIGURE MONITORING/INTERCEPTOR WELL No.M-1



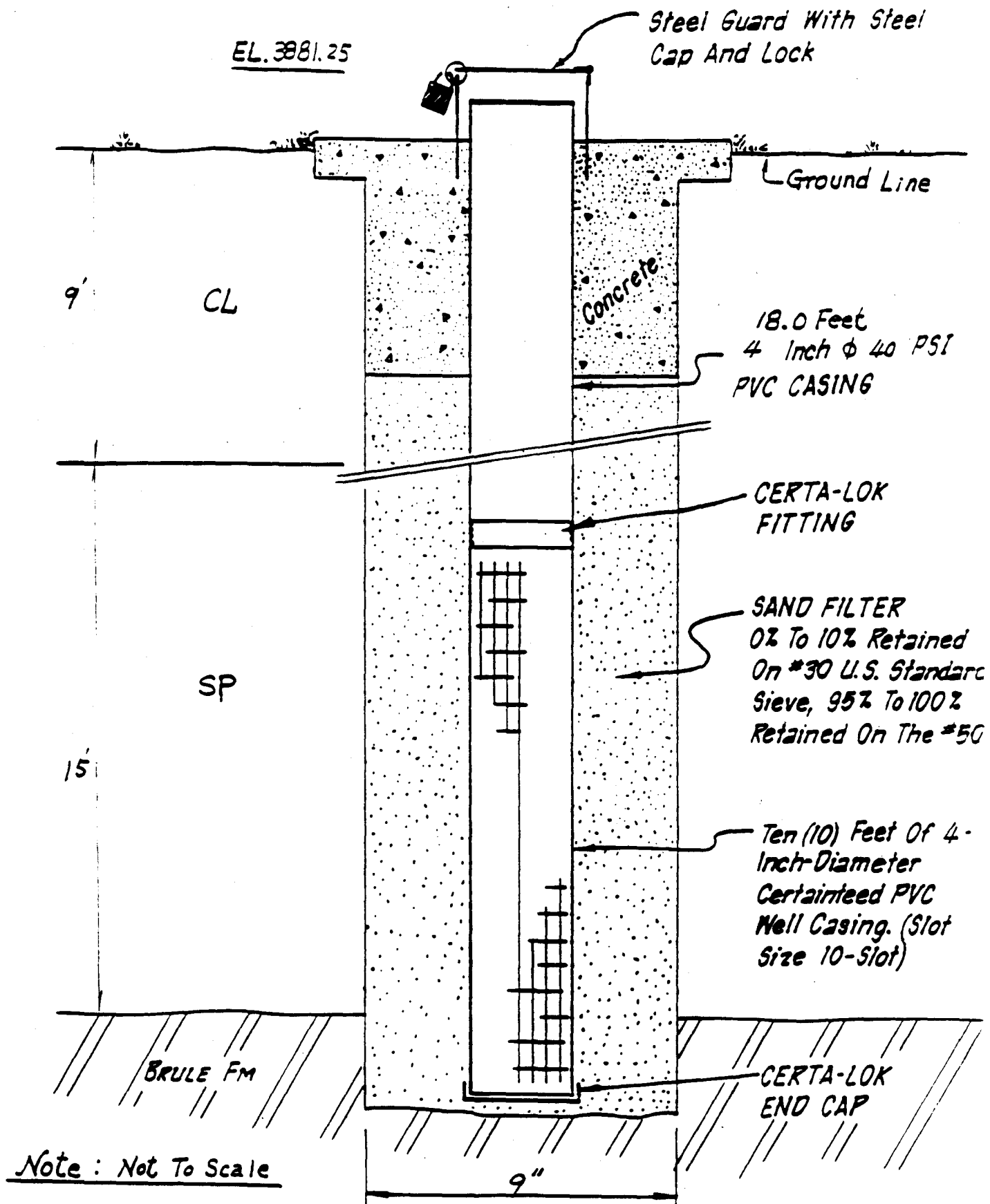
FIGURE

MONITORING/INTERCEPTOR WELL No.M-2



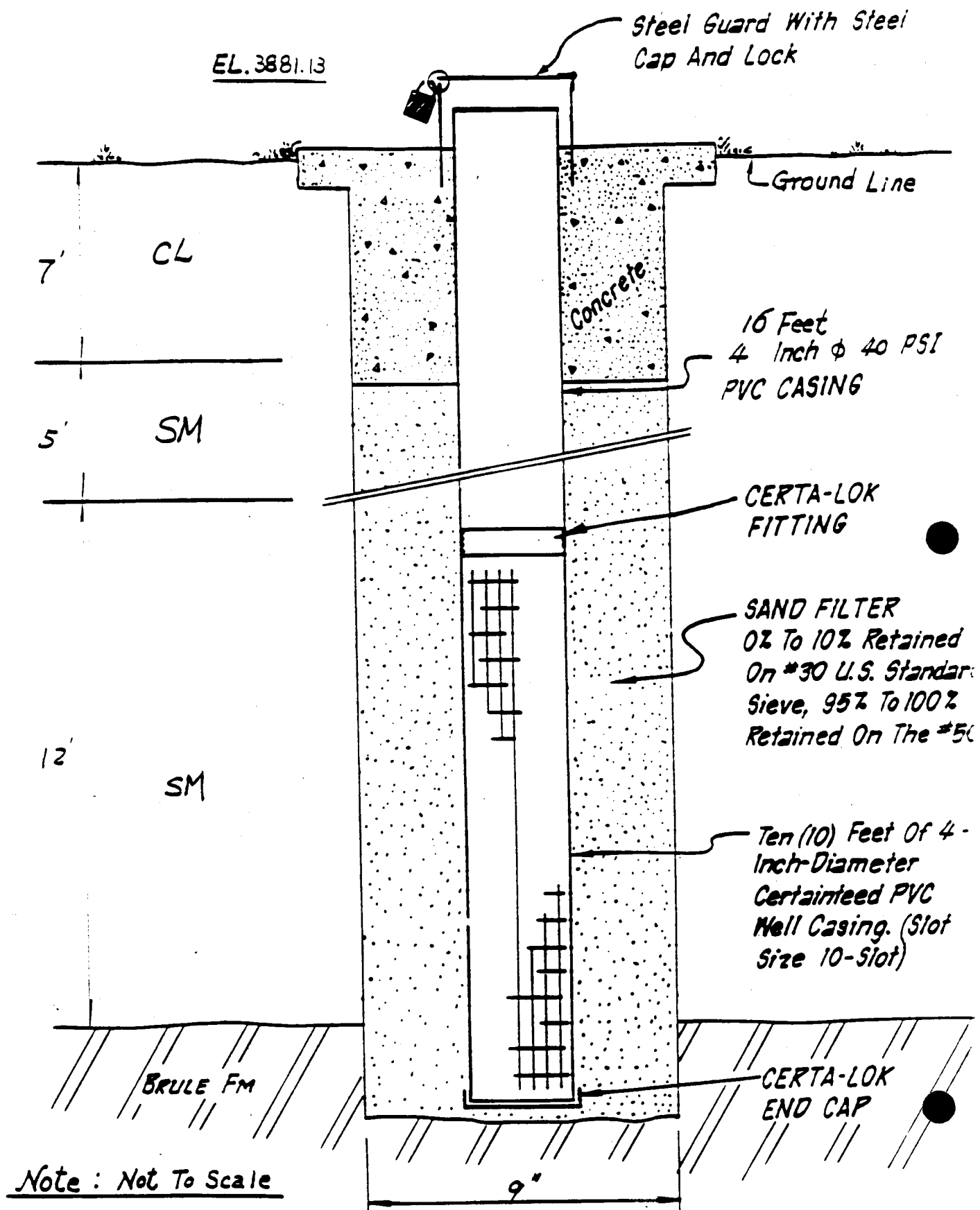
FIGURE

MONITORING/INTERCEPTOR WELL No.M-3



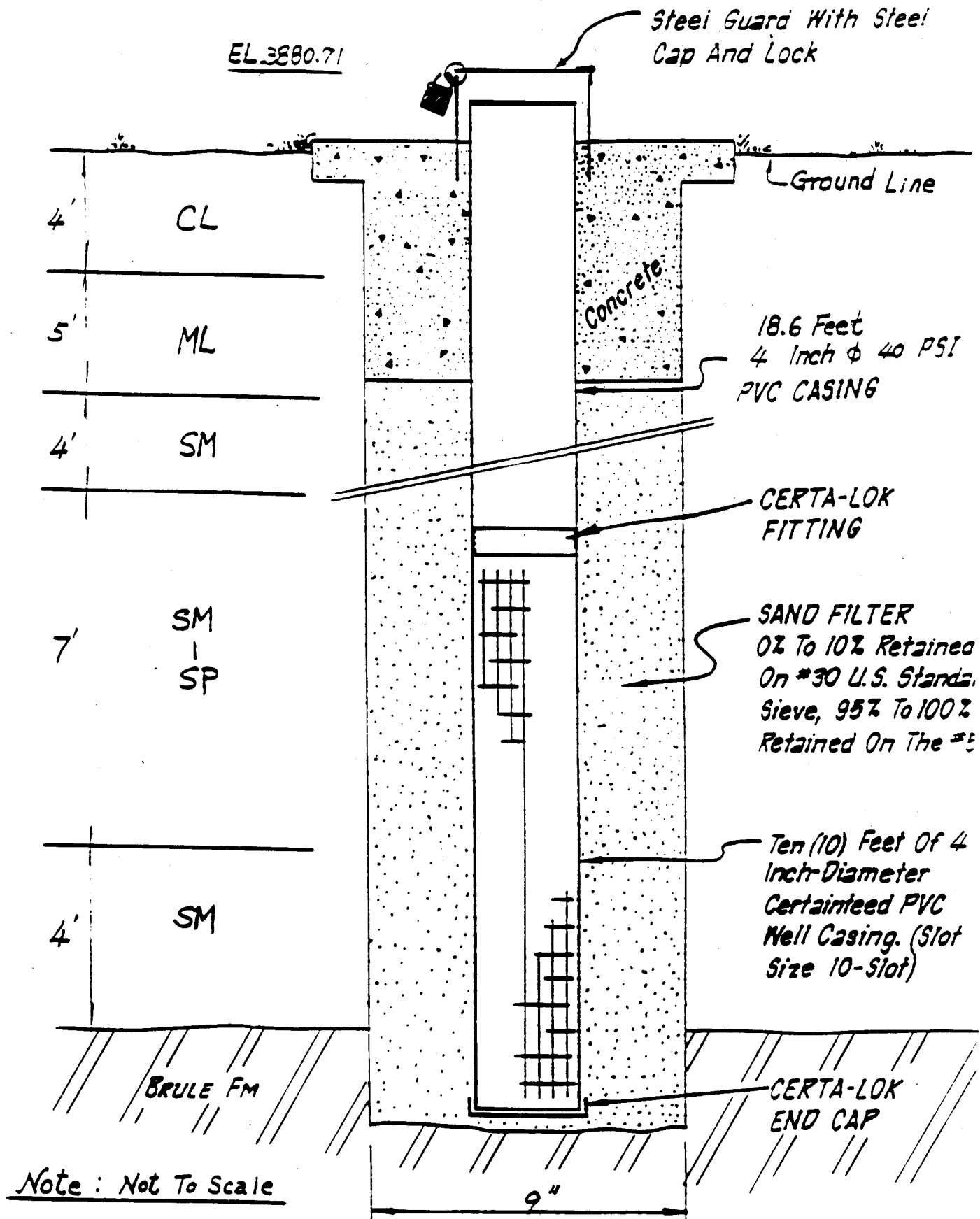
FIGURE

MONITORING/INTERCEPTOR WELL No.M-5



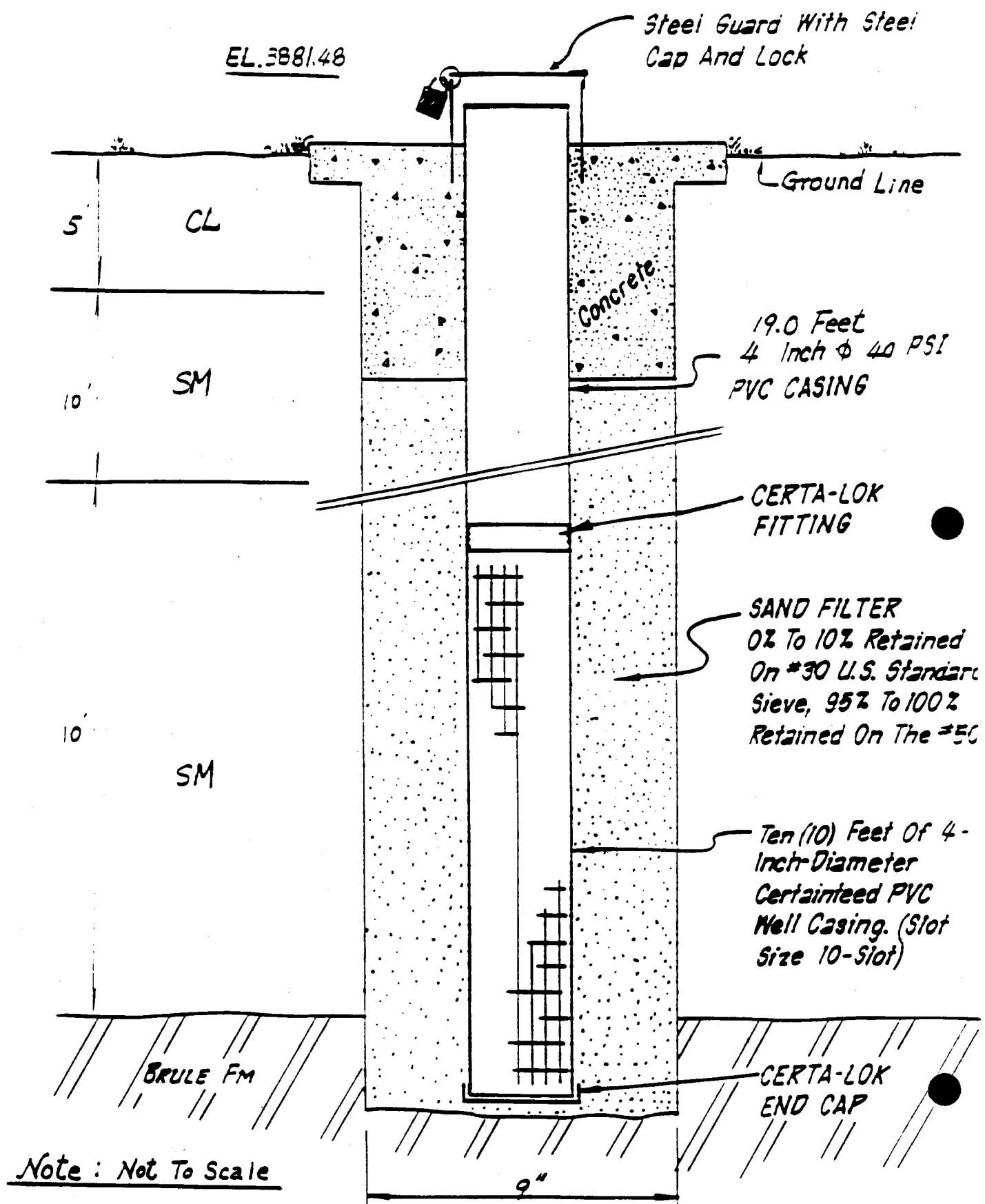
FIGURE

MONITORING/INTERCEPTOR WELL No.M-7



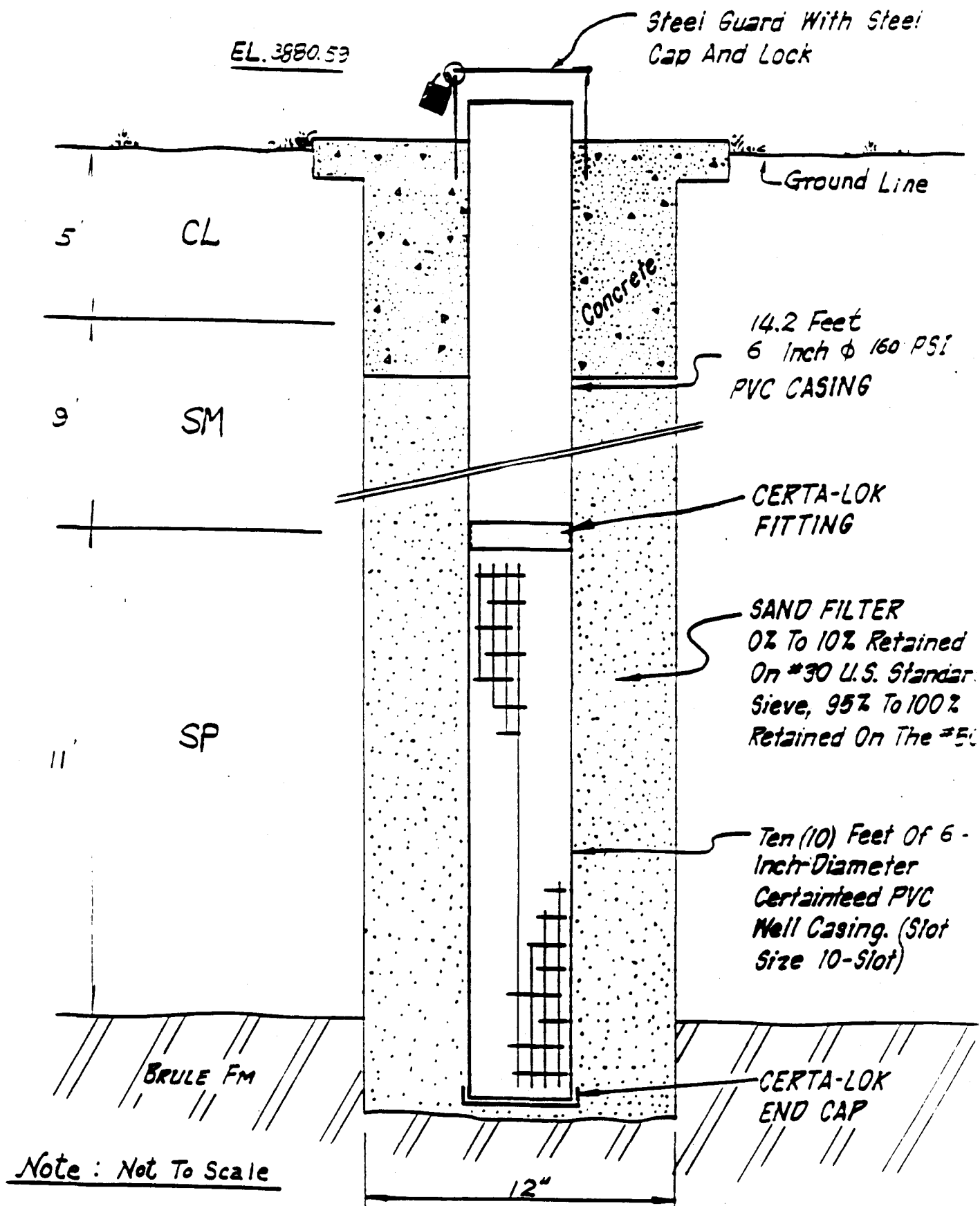
FIGURE

MONITORING/INTERCEPTOR WELL No.M-8



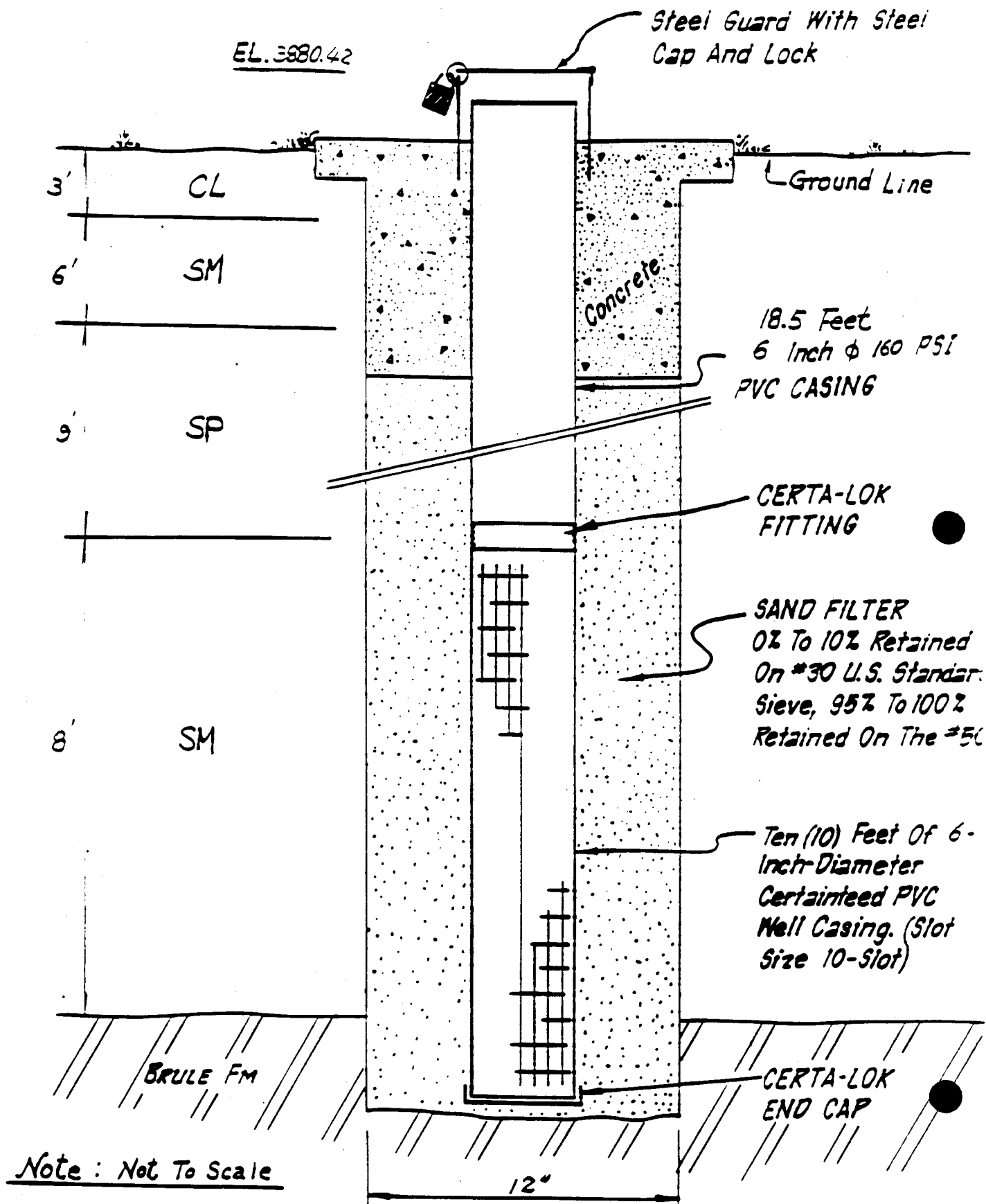
FIGURE

MONITORING/INTERCEPTOR WELL No. MI-1



FIGURE

MONITORING/INTERCEPTOR WELL No. MI-2

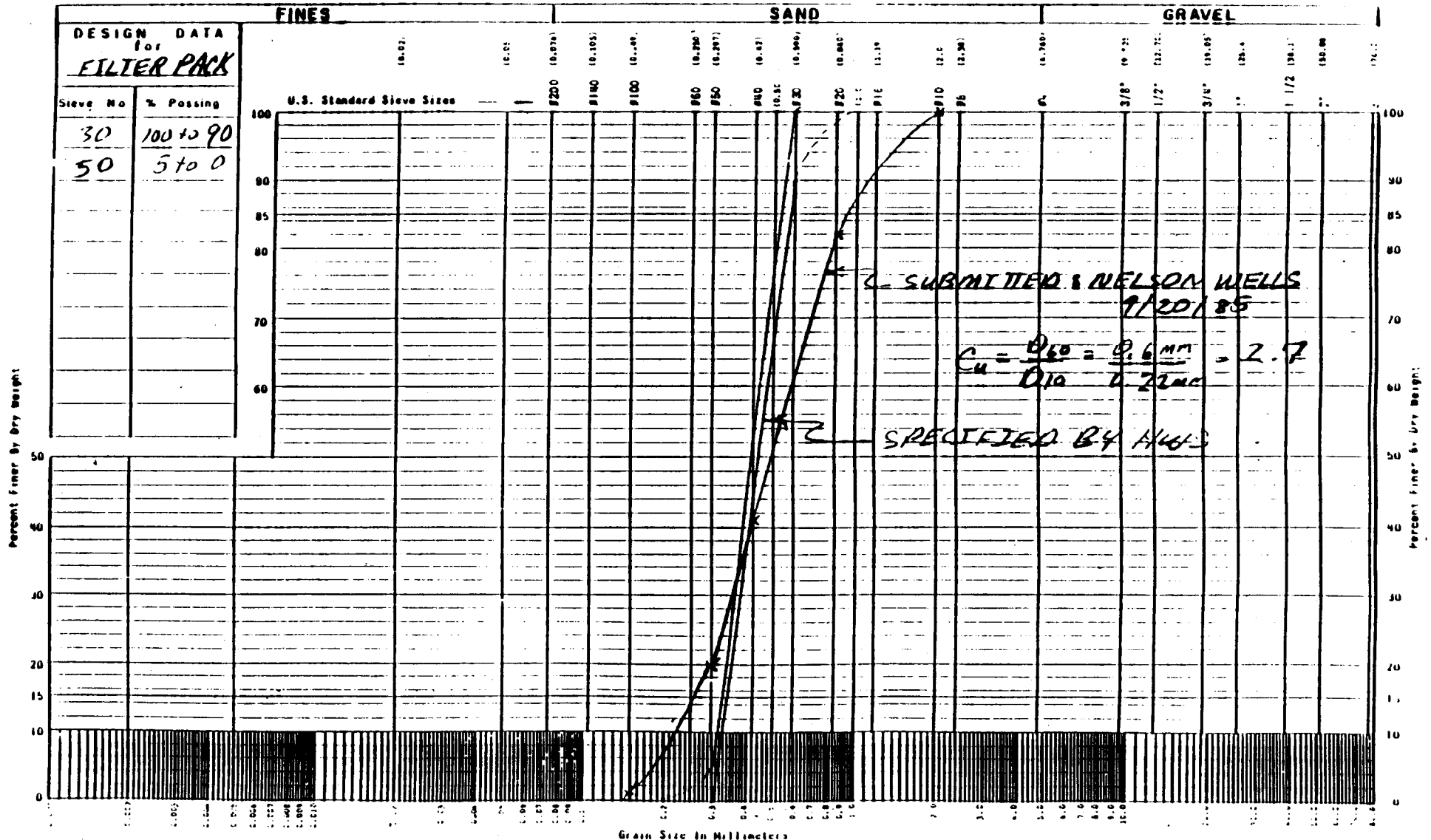


**WESTERN LABORATORIES,
MATERIALS ENGINEERS**

GRAIN SIZE DISTRIBUTION GRAPH

Project ACID LIQUOR POND MONITORING WELLS

Location LOCKWOOD CORP.



Phone 762-1592

NW	NE
SW	SE

Test Hole No. 11 - 1
Date Dec 6 1982
Customer Locking Comp.
Address Gwinnett, MD
Location Waste Lagoons
Logged By G. Nelson

TEST HOLE LOG

[illegible]

REMARKS: Installed 10' 4" Sch 40 PVC .010" Slotted Screen
Installed 14' 8" 4" Sch 40 PVC Plain 4 Square

Static Water
Level_____

Use 200 Gallons Drilling Fluid:
Used Sodium Bentonite to Drill

Purpose: 3 GPM. for 3 1/2 Hrs

NW	NE
SW	SE

Used 300 Gallons Drilling Fluid
Used Sodium Bentonite
Produced 30 GPM Pumped 1 Hr/

Used 150 Gallons Drilling Fluid Used Sodium Bentonite
Pumped 7 GPM for 1 1/2 Hrs.

NW	NE
SW	SE

Used 400 Gallons Drilling Fluid No bentonite used
Pumped 10 GPM for 2 Hrs.

NW	NE
SW	SE

TEST HOLE LOG

[illegible]

REMARKS:

Installed 10' 1/2" Titan 1/2 Square .010 Slot PVC
Installed 20' 1/2" Titan 1/2 Square Plain PVC

Static Water Level

Use: approx. 600 Gallons Drilling Fluid
Drilled without Bentonite
Pumped 15 GPM for 1 1/2 hrs.

Phone 762-1592

NW	NE
SW	SE

Test Hole No. M - 7
Date Oct. 8, 1985
Customer Lockwood Corp
Address Gering, NE
Location Waste Lagoon Area
Logged By Glenn Nelson

TEST HOLE LOG

[illegible]

REMARKS: Installed 10' - 4" Sch 40 .010" Slot Titan 4 Square
Installed 18' 7" - 4" Sch 40 Plain Titan 4 Square

Static Water
Level _____

Used 500 Gallons Drilling Fluid No bentonite used
Pumps: 20 GPM for 2 Hrs.
Pumps: 35 GPM for 1 Hr.

NELSON WELLS, INC.
Fowling Rte. - Box 6A
ALLIANCE, NEBR. 69301
Phone 762-1592

NW	NE
SW	SE

REMARKS: Installed 10' - 4" Sch 40 PVC .010" Slot
Installed 19' - 4" Sch 40 PVC 4 Square

Use: 150 Gallons Drilling Fluid Use: Sodium Bentonite
Pumped 18 GPM for 1 1/2 Hrs.

Static Water Level _____

Produced 9 GPM Pumped 1 1/2 hrs.

Use: Approx. 300 Gallons Drilling Fluid
PolyGel Bentonite Use:
Pumps: 5 GPM for 4 hours

APPENDIX B
BORING LOGS AND
WELL CONSTRUCTION DETAILS
FOR LW WELLS



Water and Air Research, Inc.

CONSULTING ENVIRONMENTAL ENGINEERS AND SCIENTISTS

6821 S.W. ARCHER ROAD • P.O. BOX 1121 • GAINESVILLE, FLORIDA 32602 • TEL. (904) 372-1500 • FAX 378-1500

November 21, 1989
Project No. 66900

RECEIVED

NOV 22 1989

HWS

Mr. Tom O'Connor
HWS Engineering, Inc.
825 J Street
Lincoln, Nebraska 68502

Dear Mr. O'Connor:

Enclosed you will find the well construction details that you requested. Also included are the driller's logs for wells LW-1 thru LW-5. Well LW-6 is an existing protoshop well. Drilling logs were not taken for LW-7 and LW-8.

If you have any further questions, please do not hesitate to call.

Sincerely,

WATER AND AIR RESEARCH, INC.

Randall F. Pfahler
Randall F. Pfahler
Hydrogeologist

RFP/ljc

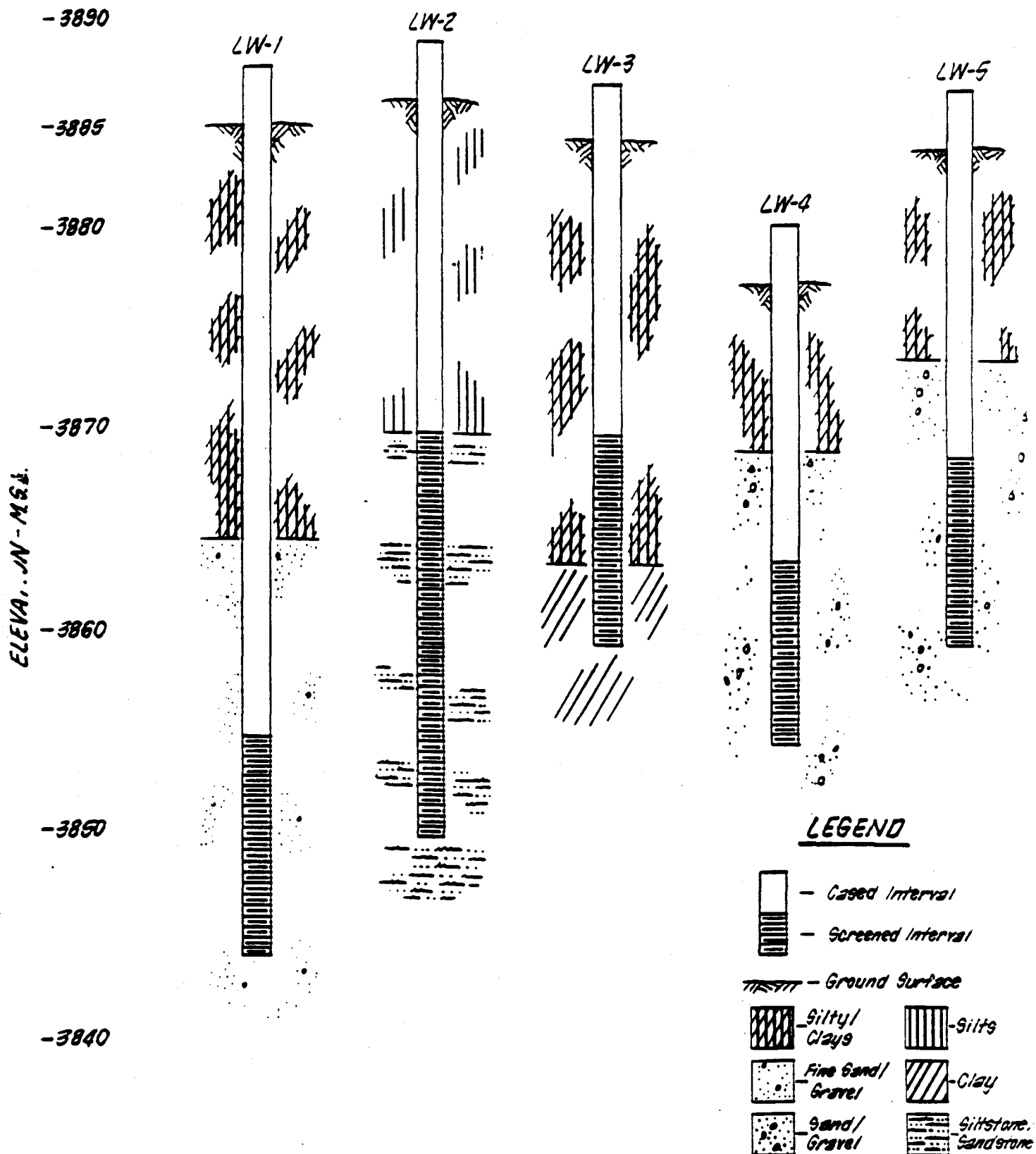
PROJECT: LOCKWOOD AUDIT

WELL CONSTRUCTION DETAILS

WELL ID	LOCATION	WATER LEVEL (btoc)	STICK- UP (ft)	WELL DEPTH (bls)	SCREEN LENGTH (ft)	GROUND	ELEVATION		
							TOP OF CASING	WATER TABLE	TOP OF SCREEN
WM-1	SW cor. of office	-18.70	1.23	41.00	10	85.77	88.00	69.10	64.77
WM-2	south of shipping	-17.40	1.72	35.44	20	95.86	97.58	70.30	70.42
WM-3	east of sheetmetal	-19.30	1.93	25.39	10	85.65	97.79	69.60	70.26
WM-4	west of salvage	-12.30	1.53	25.28	10	79.25	91.78	69.50	63.97
WM-5	sw of warehouse	-16.40	1.02	25.27	10	84.59	86.61	70.50	63.32
WM-6	protoshop well	-15.20	1.02	48-49	unknown	84.87	75.85	63.70	unknown
WM-7	east of WM-5	-17.55	1.00	29.19	10				
WM-8	north of WM-3	-19.61	1.33	31.61	15				

NOTES: All wells were constructed of 2-inch PVC well pipe
Screens were 0.01 inch slot
A 16/40 sand pack was installed to 2 feet above the top of screen.
A 2 foot bentonite seal was placed on top of the sand
Volclay grout filled the annular space from the bentonite to the surface
A steel protective cover was installed at each well
Elevations are in feet above mean sea level
Add 3000 to each elevation to obtain actual elevation
btoc - below top of casing
bls - below land surface
Elevations for WM-7 & 8 are not available yet

MONITORING WELL NO.



APPROXIMATE SCREEN PLACEMENT AND
FORMATION MATERIAL FOR WELLS LW 1-5

NW	NE
SW	SE

REMARKS: 800 lbs. 16 - 40 Colo. Silica sand pack
1 50 lb. sack of chip montonite hole plug above sand pack
Volclay grout up to surface concrete
1 2" casing centralizer on the well screen
10' of 1" Sch. 40 PVC casing screen with 1/4" slots & 33' of 2" 4 Sq. plain casing
1 bottom plug
6" diameter hole drilled
1 surface protector set on concrete with locking cap

Phone 762-1592

TEST HOLE LOG

[illegible]

REMARKS:

1 surface protector set in concrete, with locking cap

Static Water
Level _____

Static Water
Level _____

Static Water Level _____

REMARKS: 500 lbs. of 16-40 Colo. Silica Sand
1 50 lb. sack of bentonite, chip hole plug above sand
1 2" casing centralizer in center of screen
10' of 2" four square, threaded, PVC Sch 40 screen with .010 slots
17' of 2" " " " " " " plain casing
6" diameter hole drilled
Volclay grout to surfade cement
1 bottom cap
1 surfade grout in annulus

APPENDIX C

FIELD ACTIVITIES PROTOCOL

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	2.2	Equipment Calibration
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	2.4	Field Blanks
		Groundwater Samples
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Purpose

The purpose for this Sampling and Decontamination Protocol is to document the specific procedures and QA/QC requirements for a sampling or measuring activity in the field. This Protocol will apply to specific tasks and allow for data collection which will meet data quality objectives. The Protocol gives descriptions of equipment, field procedures, decontamination procedures, and QA/QC procedures necessary for soil and water sampling at Lockwood.

Guidelines

A standard Protocol will be developed and approved prior to any field activity where the Protocol will be utilized. Protocols will be prepared for each field activity including, but not limited to, soil sampling, water sampling, drilling and monitoring well installation, and decontamination. Protocols described in this appendix may be revised to include additional procedures to meet Lockwood's specific needs. The Protocols are prepared by the project manager or other qualified persons as designated by the project manager. The Protocols will be reviewed by the project manager and/or other qualified reviewers prior to EPA submittal to assure all appropriate QA/QC requirements are addressed.

Protocols set forth in this appendix are not to be used independently of the RFI workplan. The Protocols along with the work plan are developed to satisfy EPA requirements to define specific sampling procedures, field analytical procedures, and QA/QC requirements.

1.0 PROTOCOL FOR SOIL SAMPLING

1.1 Documentation

All information pertinent to sample collection and subsequent analysis will be recorded in indelible ink in a hardback, bound, identified, and sequential numbered Field Notebook. Entries will be dated and signed by the sample collector and will include the following information: field identification number, date and time collected, sampling location and sampling point, facility identification, sample type (grab, flow composite, time composite), analyses requested, preservatives added, sample matrix, description of declared components if known, observations, field measurements, etc. A Field Sampling Survey Form (attached) will be completed as each sample is collected.

1.2 Soil Sampling Technique

~~Soil samples will be collected using a drill rig and hollow stem auger equipped with a continuous sampler or split spoon sampler. Soil samples will be lithologically logged (Unified Soil Classification System) and soil samples collected at intervals stated in the RFI (three feet and seven feet) for chemical analysis. Sample bottles will be filled in the following order:~~

- ~~1. Volatile Organic Compounds (EPA Method 8240)~~
- ~~2. Metals (Total; arsenic, cadmium, chromium, lead, silver, zinc)~~
- ~~3. Other (if needed)~~

Prior to sampling, the grid areas for each SWMU will be outlined and the dimensions recorded in the site-specific logbook (measurements should be from some permanent reference point, such as a fencepost or building foundation). The number of aliquots from each grid should also be recorded along with any deviations made in the field.

All soil samples will be collected using either stainless steel spoons or trowels. The samples from each individual grid will be obtained by compositing material from the entire six-inch column from each of the aliquot locations within that grid. The soil will be collected to six inches, as described above, and a portion of the soil encompassing the total depth of the sample will be collected and placed in a clean, disposable collection container to be composited with the aliquots from the other location within the grid. After soils have been collected from each of the aliquot locations within an individual grid and placed in the collection container, the material will be thoroughly mixed manually and divided between two eight-ounce jars for shipment to the laboratory. One of the jars will be labeled for select metals analyses and the other will be labeled for semi-volatiles analyses and sealed. New gloves will be donned for sample collection in each individual grid or sample area to prevent cross-contamination.

Shallow discrete (volatile organic compound) samples will be collected using a stainless steel spoon or trowel, and the soil will be placed directly into the sample container and packed leaving as little headspace as possible. After the sample is collected, excess soil will be placed back into the hole.

Samples collected will be transported using strict chain-of-custody procedures as described in Section 1.4. The chain-of-custody/sampling request form document will be initiated by the sampler at the time of collection.

1.3 Sample Preservation

Samples destined for VOC analyses must be cooled to 4 degrees C and can not be held for longer than 14 days. Samples destined for analysis for total metals must also be cooled to 4 degrees C, but can be held up to 6 months (except for mercury). Samples collected for semi-volatile organics analyses must be cooled to 4 degrees C and extracted within seven days. Specific sample parameters, containers', preservatives, volumes, and holding times are ~~attached~~ included in Table C-1.3.

1.4 Chain of Custody and Sample Handling

Each sample container will be labeled immediately after collection with a gummed paper label indelibly inscribed with the following information: facility name, sample location and sampling point, sample depth (if applicable), sample type, sample number, date and time collected, analyses requested, preservatives added, etc.

Samples will be transferred from the sampling equipment directly into containers appropriately prepared and labeled in advance. After preservation, all sample containers will be sealed with custody tape in such a way that a violation of the sample's integrity would be evident by a broken seal. After sealing, the sample custody tape will be signed and dated by the sample collector. All sample containers will then be placed in an iced cooler and void spaces filled with packing material. A high/low thermometer will be re-set and placed in the cooler. Sample analysis request sheet and chain-of-custody documents will be sealed in a plastic bag and placed on top of the samples before sealing the shipping container with custody tape. Samples will be overnight mailed to the HWS Technologies (HWST) analytical laboratory by HWST sampling personnel. In the laboratory, samples destined for transport to other laboratories will be repacked for shipment using exactly the same procedure. Shipment to other laboratories will be made by air freight or delivered directly to the laboratory by HWST personnel within 24 hours. Chain-of-custody documents will be sealed with the samples. A copy of the chain-of-custody forms are included.

TABLE C-1.3 SAMPLE SUMMARY

Analytical Parameters	Semi-volatile organics	Volatile organics	Select metals
Concentrations	Low to Medium	Low to Medium	Low to Medium
Containers and Preservatives	8 oz. glass jar cool to 4 degrees C	Place in 2-40ml vials cool to 4 degrees C	8 oz. glass jar cool to 4 degrees C
Holding Times (from collection to analysis)	7 days for Extraction 40 days after for analysis	7 days	6 months
Sample #	Number of 8 oz jars	Number of VOA sets (2-40 ml vials)	Number of 8 oz. jars
Hazardous Waste Storage Area			
Grid A	1	2	1
Grid B	1	2	1
Grid C	1	2	1
Grid D	1	2	1
Duplicate of Grid A,B,C, or D		1	
Waste Oil Storage Area			
Grid A	1	1	1
Grid B	1	1	1
Grid C	1	1	1
Grid D	1	1	1
Scrap Metal Waste Bin Area			
Grid A	1	1	1
Duplicate	1	1	1
Raw Product Storage Area			
Grid A	1	1	1
Grid B	1	1	1
Grid C	1	1	1
Trip Blank		1	
TOTAL	13	19	13

1.5 Sample Analysis

Samples to be analyzed will be evaluated in conformance with Test Methods for Evaluating Solid Waste, EPA SW-846, Third Edition (see Appendix D). A complete listing of any additional compounds and constituents to be evaluated and their appropriate detection limits, will be submitted following analyses and interpretation of Phase I results.

The primary and secondary laboratories used in this project are listed below. The secondary laboratory will be used if the primary laboratory cannot perform the analysis for any reason or if a collaborative analysis is required.

Primary laboratory for Volatile/Semi-Volatile Organic analysis:

- ♦ A&L Mid West Laboratories, Inc.
13611 "B" Street
Omaha, Nebraska 68144

Secondary laboratory for ~~VOC~~ Volatile/Semi-Volatile analysis:

- ♦ Evergreen Analytical
4036 Youngfield
Wheat Ridge, Colorado 80033

Primary laboratory for Inorganic Analysis:

- ♦ HWS Technologies Inc.
P.O. Box 80358
825 J Street
Lincoln, Nebraska 68501

1.6 Field Blanks

Field blank samples will be used to check for contamination of samples as a result of factors at the sampling site. Field blanks will be prepared using appropriate containers brought to the sampling site and filled with deionized water at the time of the soil sampling event. The sample will be labeled with a QA/QC identifier, stored in an iced cooler, and shipped to the laboratory along with the other samples. One field blank will be prepared at the same time as the initial soil sample collection in each of the four SWMU's.

1.7 Rinsate Samples

Equipment rinsate samples will be used to check the effectiveness of decontamination procedures. A rinsate sample will be collected from the

decontaminated sampling equipment ~~core barrel prior to its use in obtaining a sample.~~ The decontaminated equipment will be rinsed with deionized water and collected in a sample bottle. The same parameters being analyzed in the samples will be analyzed for in the rinsate water. The rinsate sample will be labeled with a QA/QC identifier, stored in an iced cooler, and shipped to the laboratory along with the other samples. One rinsate blank will be collected at the same time as the initial sample collection in each of the four SWMU's.

1.8 Duplicate Samples

Duplicate samples will be collected to check for natural sample variance and consistency in field techniques and laboratory analysis. Duplicate samples will be collected at the time of initial sample collection in each of the four SWMU's. All initial samples will be duplicated. ~~The duplicate sample will be collected at the three foot depth interval and obtained from the same core barrel as the initial sample. Sample bottles for the initial sample for VOC's will be filled first, then duplicate sample bottles for VOC's, and so on until all initial and duplicate sample bottles are filled for the analysis required.~~ The duplicate sample will be handled, stored, and shipped in the same manner as the initial sample, and will be assigned a QA/QC identified. The frequency of duplicate samples to be analyzed is depicted at Table C-1.8.

2.0 PROTOCOL FOR GROUNDWATER SAMPLING

2.1 Documentation

All information pertinent to sample collection and subsequent analysis will be recorded in indelible ink in a hardback, bound, identified, and sequential numbered Field Notebook. Entries will be dated and signed by the sample collector and will include the following information: field identification number, date and time collected, sampling location and sampling point, facility identification, sample type (grab, flow composite, time composite), analyses requested, preservatives added, sample matrix and description of declared components if known, observations, field measurements, etc. A Field Sampling Survey Form (attached) will be completed as each sample is collected.

2.2 Equipment Calibration

Measuring equipment subject to calibration will be calibrated immediately prior to first use on each day that measurements are taken. Calibration will be according to the manufacturer's instructions (at 20 degrees Celsius unless specified otherwise) using a 0.0100N KCl solution for conductivity meters and NBS - traceable pH buffered solutions of pH 4.00 and 7.00 Standard Units (S.U.). Between wells, instruments will be recalibrated or verified by checking and

Table C-1.8
Quality Control
Field Quality Control Samples (Water ~~and Soil~~)

Parameters	QC Measure	Frequency
Metals (As, Cd, Cr, Pb, Zn)	1 Field Duplicate 1 Field Blank	Every 10 samples Every 10 samples
Volatile Organic Compounds	1 Trip Blank 1 Field Duplicate 1 Field Blank	Each day Every 10 samples Every 10 samples

recording the value of a known check sample. If a pH greater than 7.00 S.U. is measured, the pH meter will be recalibrated using a pH 7.00 and pH 10.00 buffer solution.

2.3 Water Sampling Technique

Sampling at each well must proceed in the sequence listed below.

2.3.0 Vapor Readings

Immediately upon removing the monitoring well cover, an organic vapor detector (HNU device) shall be inserted in the well and the meter reading shall be recorded in the field book and on the field sampling survey form.

2.3.1 Evaluation for Potential Floating Immiscible Layer

As detailed in Section 6.2, a shallow well designed to monitor the surface of the water table will be installed in the Used Oil and Empty Barrel Storage Area. For this well only, a check for potential floating, immiscible fluids will be made prior to purging. This will be accomplished using an electronic interface probe. If a floating layer is present, its thickness will be measured, and a sample will be collected using a top-filling bailer.

~~2.3.1~~

2.3.2 Depth to Water

The measuring point for each well will be marked on the casing and a measuring point surveyed. The measured total well depth and depth to water shall be recorded on the field survey form to the nearest 0.01 feet and shall be measured by an electrical water level indicator. The measurements shall be rechecked before the probe is removed from the well.

~~2.3.2~~

2.3.3 Purging Standing Water

A minimum of three well volumes must be purged from each well with a teflon bailer. Temperature, conductivity, and pH measurements will be taken after evacuation of each well volume to determine whether water chemistry has stabilized. The parameters of temperature, pH, and conductivity shall be deemed stabilized when readings are within 10 percent over two successive well volumes. If chemistry has not stabilized purging will continue, with measurements taken after one-half well volume.

The following formula shall be used to calculate the minimum volume of water to be purged.

$$P = (\pi r^2)(B-S)(7.481)(3)$$

where P = volume of water to be purged in gallons.

r = the radius of the well in feet.

B = the depth to the bottom of each well in feet (see Appendix A for the specific dimensions of each well)

S = the depth to the surface of the water column in feet (this measurement must be made in the field).

7.481 = numerical constant to convert volume in cubic feet to gallons.

3 = minimum number of well volumes which must be purged before collecting the sample.

~~2.3.3~~

2.3.4 Sample Collection Technique

Samples for chemical analysis will be collected within two hours after purging is completed. For slow recovering wells, the sample shall be collected immediately after a sufficient volume is available. The water quality samples shall be taken from within the well screen interval. The following sample procedure is to be used at each well:

- 1) New nylon rope will be used for each bailer at each well for each sampling event.
- 2) Sample labels will be filled out for each well.
- 3) The bailer will be lowered slowly and gently into contact with the water in the well. The bailer will be lowered to the same depth in the well each time, within the screened interval.
- 4) The bailer will be retrieved smoothly and the water emptied in a slow, steady stream into the sample container.

~~2.4 Field Blanks~~

~~Sampling techniques shall be consistent with industry standards and EPA requirements. A minimum of one in ten groundwater samples collected for each analyte shall be a field duplicate sample taken to evaluate the representativeness of sampling procedures. For each day of sampling, for all analytes, a transport blank shall be prepared by filling the appropriate container with deionized water in the analytical laboratory. It shall be handled and transported exactly as a sample. A rinsate blank shall be collected from the~~

~~final decontamination rinse water from each boring site. It will be labeled with a QA/QC identifier, and transported exactly as a sample. The results of analysis of field duplicates and transport blanks shall be included in the final analytical report.~~

2.4 Groundwater Samples

Groundwater samples will be collected from the five monitoring wells that will be installed during the RFI, and existing monitoring wells MW-1, MW-4, MW-5, MW-8, LW-1, LW-2, and LW-4.

With the exception of the shallow monitoring well that will be installed in the Used Oil and Empty Barrel Storage Area, which will be sampled for Total Recoverable Petroleum Hydrocarbons only, all monitoring wells listed above will be sampled for each of the following analytes:

Volatile Organics

Containers:	Two 40-ml VOA vials
Preservative:	Cool to 4 degrees Celsius immediately after collection
Maximum holding time:	7 days

Total Recoverable Metals

Container:	One 1-liter polyethylene
Preservative:	Nitric acid to pH <2, then cool to 4 degrees Celsius immediately after collection
Maximum holding time:	6 months

Total Cyanide

Container:	One 1-liter polyethylene
Preservative:	Sodium hydroxide to pH >12, then cool to 4 degrees Celsius immediately after collection
Maximum holding time:	28 days

Sulfate

Container:	One 1-liter polyethylene
Preservative:	Cool to 4 degrees Celsius immediately after collection
Maximum holding time:	28 days

Nitrate

Container: One 1-liter polyethylene
Preservative: 2 ml concentrated sulfuric acid/liter, then cool to 4 degrees Celsius immediately after collection
Maximum holding time: 48 hours

Total Recoverable Petroleum Hydrocarbons

Container: One 1-liter glass bottle
Preservative: 5 ml 1:1 hydrochloric acid/liter, then cool to 4 degrees Celsius immediately after collection
Maximum holding time: 48 hours

~~2.5 Sample Preservation~~

~~Samples destined for VOC analyses must be cooled to 4 degrees C and can not be held for longer than 14 days. Samples destined for analysis for total metals must also be cooled to 4 degrees C, but can be held up to 6 months (except for mercury). Specific sample parameters, containers', preservatives, volumes, and holding times are attached.~~

2.5 Field-Collected Quality Assurance/Quality Control (QA/QC) Samples

Three types of samples will be used to ensure adequate QA/QC. These samples include the following:

Duplicates

A minimum of one out of every 10 complete sets of groundwater parameters will be duplicated; i.e. two complete sets of samples will be collected from at least one out of every 10 monitoring wells sampled. For this project, 12 monitoring wells will be sampled, therefore two sets of duplicates will be collected from two wells. Both sets of duplicates will be complete sets of all parameters listed in Section 2.4 of this appendix, and may be collected from any two monitoring wells, excluding the shallow well in the Used Oil and Empty Barrel Storage Area (which will be sampled for only one parameter).

Equipment (Rinsate) Blanks

Equipment blanks will be collected to ensure that decontamination procedures are adequate. One complete set of these blanks for all

parameters will be collected for every 10 wells sampled; for this project two sets of equipment blanks will be collected. The samples will be obtained from the final distilled water rinse of the sampling equipment during decontamination. Equipment blanks will be handled and preserved in the same manner as regular and duplicate samples.

Trip Blanks

Trip blanks are QA/QC samples which pertain only to samples for volatile organic compound (VOC) analysis. One trip blank consists of two 40-ml VOA vials, filled with organic-free water. They are filled by the laboratory which will perform the VOC analyses, and shipped to the site by the lab. During groundwater sampling, the field team will include one trip blank in each sample cooler that contains samples for VOC analysis.

2.6 Chain of Custody and Sample Handling

Groundwater samples will be transferred from the sampling equipment directly into containers appropriately prepared and labeled in advance. After preservation, all sample containers will be sealed with custody tape in such a way that a violation of sample's integrity is shown by a broken seal. After sealing the sample custody tape will be signed and dated by the sample collector. All sample containers will then be placed in an iced cooler and void spaces filled with styrofoam packing material. A high low thermometer will be reset and placed in the cooler. Sample analysis request sheets and chain of custody documents will be sealed in a plastic bag and placed on top of the samples before sealing the shipping container with custody tape. Samples will be taken or shipped to the HWST laboratory directly by sampling personnel. In the laboratory, samples destined for transport to other laboratories will be repacked for shipment using exactly the same procedure. Shipment to other laboratories will be made by air freight or delivered directly to the laboratory by sampling personnel within 24 hours. Chain-of-custody documents will be sealed with the samples. The primary and second laboratories used in this project are listed below. The secondary laboratory will be used if the primary laboratory cannot do the analysis for any reason or if a collaborative analysis is required. A copy of a chain-of-custody form is included.

2.7 Sample Analysis

Samples to be analyzed will be evaluated in conformance with Test Methods for Evaluating Solid Waste, EPA SW-846, Third Edition (see Appendix D). A complete listing of any additional compounds and constituents to be evaluated and their appropriate detection limits, will be submitted following analyses and interpretation of Phase I results.

The primary and secondary laboratories used in this project are listed below. The secondary laboratory will be used if the primary laboratory can not perform the analysis for any reason or if a collaborative analysis is required.

Primary laboratory for Volatile/Semi-Volatile Organic analysis:

- ♦ A&L Mid West Laboratories, Inc.
13611 "B" Street
Omaha, Nebraska 68144

Secondary laboratory for Volatile/Semi-Volatile Organic Analysis:

- ♦ Evergreen Analytical
4036 Youngfield
Wheat Ridge, Colorado

Primary laboratory for Inorganic Analysis:

- ♦ HWS Technologies Inc.
P.O. Box 80358
825 J Street
Lincoln, Nebraska 68501

Secondary laboratory for Inorganic Analysis:

- ♦ A&L Mid West Laboratories, Inc.
13611 "B" Street
Lincoln, Nebraska 68144

3.0 EQUIPMENT DECONTAMINATION

3.1 Drilling Equipment

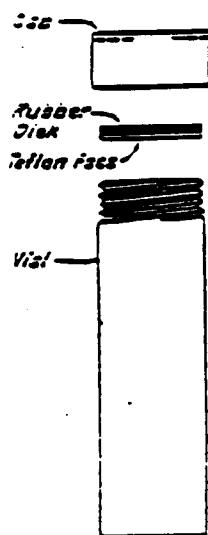
All drilling equipment including augers and downhole sampling equipment shall be thoroughly cleaned with a hot water high-pressure washer before entering the site, before using the equipment at the next drilling site, and before leaving the site. A decontamination area will be established at the site, and all drilling equipment will be moved to the decontamination area for washing.

3.2 Sampling Equipment

All field test and sampling equipment which comes into contact with the sample including water level probes, pH and specific conductance probes, and bailers shall be thoroughly decontaminated before proceeding to the next sampling site. The field equipment will be cleaned with a nonphosphate detergent, followed by a rinse with tap water and a final rinse with distilled water.

Sampling for volatiles in water can be used in determining if water has been contaminated with any of a large number of organic solvents and fuels. Since the compounds in the water are volatile, they tend to escape from the water if exposed to air. The vials the lab sends out insure that there is no loss of the contaminant during shipping. Careful attention to the filling instructions will result in accurate results from the lab.

Before filling the vials note which side of the rubber disk will contact the water. There is a white teflon coating to protect the sample against leaks and contamination from the rubber part of the disk.



1. Before handling the bottles make sure your hands are cleaned of dirt, grease and oil.
2. Run the water for two minutes before sampling.
3. Close the valve until flow is about the diameter of a pencil (aerator should not be working).
4. Take the cap off of the vial and separate the disk from the cap.
5. Fill the vial and fill it making sure no air bubbles through the water. Hold it straight up when the level gets near the top. Fill till the water rises a little over the top of the glass lip.
6. Carefully place the vial on a flat surface.
7. Hold the rubber disk (teflon face down) by the edges and put it straight down on the top of the vial. Some water should ooze out from under the disk.
8. Carefully put the cap over the vial.
9. Put a finger through the hole in the cap and (lightly) press on the disk while tightening the cap. You should feel the cap compress the rubber disk slightly. Over tightening can cause the disk to pop out.
10. Turn the vial upside down and tap it on the palm of your hand. No bubbles should be in the vial. If some show, refill the vial.
11. Fill 3 vials. Put them in their original shipping container for return to the lab.

Note that there is a filled vial marked "Blank". Do not open this vial. Return this vial along with the two you filled by placing them in the pre-addressed return mailer. Send samples by first class mail.

SAMPLING TECHNIQUE FOR VOLATILE ORGANIC ANALYSIS

THE WATER SUPPLYING FIELD SURVEY FORM

Casefile Equipment 3-Can before Sampling this well _____

Depth of water before pumping _____ ft. Time _____ Diameter of well _____ inches

Pump at Well Section/ yes _____ to _____ Depth of Pump Setting _____ feet

Time Pumping begins _____ Notes on Initial Discharge _____

[illegible]

SECRET

ANALYST

WELL CONSTRUCTION SUMMARY

PROJECT NAME _____ WELL _____

PROJECT NUMBER _____

STATE _____ COUNTY _____ LOC. _____ SEC. _____ T. _____ N. R. _____

LOCAL DESCRIPTION _____

LOCATED IN (CIRCLE): UPLAND, SIDE SLOPE, TERRACE, BOTTOMLAND, RAVINE, SAND DUNES.

ELEVATION: GROUND LEVEL _____ TOP OF CASING _____

DRILLING SUMMARY:

TOTAL DEPTH _____

BOREHOLE DIAMETER(S) _____

DRILLING COMPANY _____

DRILLING CREW _____

GEOLOGIST _____

RIG _____

BIT(S) _____

DRILLING FLUID _____

SURFACE CASING _____

WELL DESIGN:

CASING _____

SCREEN _____

CENTRALIZERS _____

FILTER MATERIAL _____

GROUT _____

SURFACE SEAL _____

OTHER _____

CONSTRUCTION TIME LOG:

TASK	START		FINISH	
	DATE	TIME	DATE	TIME
DRILLING				
GEOPHYS. LOGGING				
CASING				
FILTER PLACEMENT				
CEMENTING				
DEVELOPMENT				
OTHER				

WELL DEVELOPMENT

COMMENTS

BORING LOG

Project Name:				Boring #:	Page	of
City, State:				Time Start:	Date:	
Project Number:				Time End:	Date:	
Location:				Weather Conditions:	Initials of Driller (s)	
IAD Depth to Water:		Type of Rig, Method of Boring:				Initials of Logger
Final Depth to Water:		Sampling Method:				Casing/Screen (ft):
Surface Elev.	Depth (ft)	Group Symbol	Description of materials	Sample No. & %	HNU (ppm)	Remarks

APPENDIX D

**ANALYTICAL QUALITY ASSURANCE/
QUALITY CONTROL**

HWS TECHNOLOGIES INC.
QUALITY ASSURANCE MANUAL
ANALYTICAL LABORATORY

HWS TECHNOLOGIES INC.
825 "J" Street
Lincoln, Nebraska

Effective September 1, 1989

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Subcontracting

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PURPOSE OF MANUAL

HWS provides service, through professional engineering and environmental consulting practices, to reach clients that have need of our help. Working with them, we are improving the quality of life for them and those who they serve. Basically, we are accomplishing this in two different ways. One is to help them develop facilities which improve life's quality and the other is to help them remove barriers to the enjoyment of a higher life quality.

WE SERVE PEOPLE'S NEEDS TO IMPROVE THE QUALITY OF LIFE.
WE ACHIEVE SOLUTIONS THROUGH SERVICE.

The objective of the HWS Technologies (HWST) Analytical Laboratory is to produce high quality, reliable analytical measurements and data that are adequate for their intended purposes. The management and staff of HWST are dedicated to excellence in measurement and to the provision of the physical and intellectual environment conducive to the achievement of these objectives.

The purpose of this document is to describe the quality assurance practices within the Analytical Laboratory. A further purpose is to inform users of the HWST Analytical Laboratory's expertise.

The HWS management and staff advocate the development and use of the best measurement practices as dictated by each measurement situation. It is the policy of the HWST Analytical Laboratory to document the experimental details in each individual case and maintain them as a matter of record.

ANALYTICAL LAB

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LABORATORY DESCRIPTION

Since 1978, HWS Technologies Inc. has maintained an analytical laboratory offering a broad range of capabilities, utilizing modern instrumentation and equipment. The following laboratory services, including both sampling and analysis, are provided to industrial, governmental, commercial, and institutional clients:

- Hazardous Waste Analysis
- Solid Waste Analysis
- Potable Water Analysis
- Wastewater Analysis
- Spill Monitoring
- Air Monitoring
- Water and Waste Sampling
- Groundwater Sampling and Analysis
- PCB Sampling and Analysis

Methods

Sampling: Appropriate protocol for suspected contaminated materials and surface areas are incorporated.

Analysis: EPA and other agency approved methods of laboratory analysis and quality control are used on all samples. The specific needs of each situation determine which method will be used.

The EPA approved methods listed below are followed.

For soil, sludge, and hazardous waste:

"Test Methods for Evaluating Solid Waste", EPA SW-846, Third Edition

For water and wastewater:

"Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", EPA 600/4-82-057.

For PCB analysis in oil and transformer fluid:

"Test Methods for the Determination of Polychlorinated Biphenyls in Transformer Fluid and Waste Oils", EPA 600/4-81-045.

LABORATORY ENVIRONMENT

Facilities

1. The HWS Technologies Analytical Laboratory, located at 825 J Street in Lincoln, Nebraska, is shown in the appended floor plan. Over 800 square feet of the facility is devoted to laboratory operation, with 35 linear feet of useable bench space for approximately 5 analysts. Sample storage, preparation, and instrumental analysis by atomic absorption spectrophotometry or gas chromatography are segregated in separate rooms.
2. Laboratory pure water meeting ASTM Type I and II specifications is provided on site by an ion-exchange/activated carbon filtration system and a Barnstead Nanopure 550 system capable of delivering 2 liters per minute. The resistivity is monitored constantly by an inline meter. In addition, the suitability of the water is monitored on a regular basis with results recorded in the Laboratory Pure Water Logbook.
3. Adequate electrical service is provided for all equipment. Voltage control units protect all equipment susceptible to failure or damage resulting from fluctuating line voltage.
4. An exhaust hood for the atomic absorption spectrophotometer and two fume hoods for protection from organic vapors are provided and are checked yearly for adequate flow.
5. Vacuum Pumps
6. Support facilities; storage, office, computing, drafting etc.

Equipment

The HWS Analytical Laboratory employs a variety of sophisticated instrumentation for laboratory analysis and field investigations. Written procedures cover the routine maintenance and calibration of all major equipment and are followed to ensure peak performance. Appended is a complete listing of all major laboratory and field equipment. Calibration and maintenance are covered in detail in SOP - 7.

PERSONNEL

Minimum Requirement and Job Responsibilities.

The HWS Analytical Laboratory provides specific job descriptions to each employee and maintains copies in the personnel file. Listed below are minimum requirements and specific duties relating to the QA/QC program for each position.

A. Laboratory Director

1. Academic Training: A bachelor's degree in a scientific or engineering discipline. Alternately, five years of experience in laboratory management plus twenty semester hours in chemistry from an accredited college or university.
2. Experience: Two years of experience with physical and chemical measurements.
3. Review QA operations and make decisions on major QA procedures.

B. Analytical Laboratory Manager

1. Academic Training: A bachelor's degree in chemistry. Alternately, five years of experience with analytical measurements, with twenty semester hours in chemistry from an accredited college or university.
2. Experience: Two years of experience with environmental analytical measurements.
3. Implement quality control procedures and ensure that they are being followed by analysts, train analysts, supervise equipment maintenance and calibration, evaluate personnel performance, review results from diagnostic program and recommend corrective actions, inform management of major quality control problems.

C. Laboratory Analyst

1. Academic Training: A high school diploma or equivalent.
2. Experience: On-the-job training followed by successful analysis of performance evaluation samples.

3. Follow written methods and standard operating procedures, record results of quality control sample analysis, identify and correct minor problems, report out-of-control situations to Analytical Laboratory Manager.

D. Laboratory Quality Control Officer

1. Academic Training: A Bachelor's Degree in Chemistry. Alternately, five years of experience with analytical measurements, with twenty semester hours in Chemistry from an accredited college or university.
2. Experience: Two years of experience with environmental analytical measurements.
3. Perform inspections of laboratory procedures and practices, writing reports, and providing follow-up action. Forwarding audit reports to the responsible management personnel for corrective action. Coordinating Q.A. activities such as changes in policy or procedures among the responsible management personnel for implementation. Maintaining records of proficiency testing and of the certification certificates.

Personnel Training

- A. New Employee Training: Employee training is varied to fit the previous experience of the analyst and the specific requirements of the analysis he will be performing. At the minimum, each employees training will include the following:
 - 1. Laboratory safety procedures explained by the personnel officer or Analytical Laboratory Manager.
 - 2. Reading the Quality Assurance manual and Standard Operating Procedures.
 - 3. Reading the approved method for each assigned analysis.
 - 4. On-the-job training with experienced personnel followed by satisfactory analysis of quality control samples.
- B. Continuing Training: It is the responsibility of each employee to keep abreast of advances in methodology, laboratory operations, instrumentation, and quality control procedures. To facilitate this, HWS encourages membership in professional organizations, attendance at scientific meetings, special training courses, and through subscription to scientific and technical periodicals. The company is willing to share the costs of such activities when they are demonstrated to be in the company's best interest.
- C. The details of personnel training and its documentation are covered by SOP-4.
- D. HWS Technologies has developed an organizational chart and biographical sketches of personnel closely involved with the quality assurance program of the Analytical Laboratory (refer to the following pages).

Resumes follow for the key personnel listed.

Paul K. Mignon

Douglas W. Moon

Michael J. Rush

Robert Sechrest

Richard Wozniak

Paul K. Mignon is Manager of the Analytical Laboratory of HWS Technologies Inc. He is responsible for the supervision of all aspects of the analytical testing of inorganic and organic constituents in water, wastewater, industrial effluents, construction materials, and soils.

Mr. Mignon is experienced in the operation of the gas chromatograph, UV-visible spectrophotometer, atomic absorption units, and pH meters, as well as other laboratory instruments.

Representative project experience includes:

Air monitoring for formaldehyde by NIOSH approved methods for a large shopping center.

Air monitoring to estimate discharge quantities of organic chemicals to the environment for compliance with the Community Right-to-Know Program.

Method development and analysis of hydrocarbon contamination in environment (i.e. diesel fuel, gasoline, solvents).

Gas chromatography analysis of jet fuel-contaminated soil.

Gas chromatography analysis of PCB-contaminated transformer oil and soil.

On-site technician in charge of water quality monitoring and waste treatment of a cyanide heap leach facility spill in Idaho.

In addition, Mr. Mignon participated in a "Symposium on Cyanide Heap Leach Operations: Analysis and Treatment," sponsored in part by the Idaho Department of Environment, Boise, Idaho.

Education: A.A.S. in Environmental, Laboratory Technology,
Southeast Community College, Lincoln, Nebraska, 1983
Class IV Certificate: Kansas Water Pollution Control Assoc.
Attended University of Nebraska-Lincoln
OSHA Training 29 CFR Part 1910.120(e) (40 hours plus 8 hours
management training)

Professional Activities: Member: Association of Official
Analytical Chemists

Continuing Education: Seminars - New Challenges in Environmental Analysis; GC/MS, Finnigan Mat, Kansas City, Missouri; Laboratory Quality Assurance and Assessment for Environmental Testing, American Association for Laboratory Accreditation Center for Energy and Environmental Management, Chicago, Ill.
Symposium: Cyanide Heap Leach Operations: Analysis and Treatment, DuPont and Idaho Department of Environment, Boise, Idaho

Professional Experience: With HWS since 1983

Douglas W. Moon is an Environmental Scientist responsible for performing sampling and analysis of water, wastewater, soils, suspected hazardous waste, and building materials in accordance with approved professional and regulatory methodology. He assists with sample handling in the laboratory, including reporting procedures, invoicing, designation of analysis, sample preparation, and sample preservation.

Mr. Moon is experienced in the operation of atomic absorption gas chromatography, flow injection analyzer, UV-visible spectrophotometer, inductively coupled plasma spectrophotometer, as well as other laboratory instruments.

Representative project experience includes:

Atomic absorption spectroscopy analysis for toxic metals in the environment.

Field technician for water sampling at various hazardous waste sites. Responsibilities include instructing clients in proper sampling procedures and preservation.

Field technician for geologic investigation at various sites.

Nutrient analysis of agronomic samples.

Assisting with pesticide economic feasibility research projects including graduate level research on Sunflower Seed Weevils project.

In addition, he has taught biology and physical science at the secondary level.

Education: B.S. in Biology, South Dakota State University, 1987

Continuing Education: GC/MS Seminar, Edward Ledford, Ph.D.
OSHA Training 29 CFR Part 1910.120 (e) (40 hours)

Professional Experience: With HWS since 1989

Formerly with Harris Laboratories, Laboratory Technician, 1987-1989; Brookings Public School District, Instructor, 1987; Sioux Valley Public School System, Coach, 1986-87; South Dakota State University Plant Science Dept., Research Assistant, 1983-85

Michael J. Rush is an Analytical Laboratory Technician responsible for performing inorganic and organic analysis of water, wastewater, soils, suspected hazardous waste, and building materials in accordance with approved professional and regulatory methodology. He assists with sample handling in the laboratory, including reporting procedures, invoicing, designation of analysis, sample preparation, and sample preservation.

Representative project experience includes:

Ongoing chemical analysis of samples from industry and municipalities.

Field technician for sampling at various wastewater discharge sites. Responsibilities included instructing clients in proper sampling procedures.

Education: A.A.S. in Environmental Laboratory Technology,
Southeast Community College, 1988

Professional Activities: Water Distribution Operator,
Nebraska

Professional Experience: With HWS since 1988
Formerly with Harris Laboratories, 1988 (Coop Education);
Dorsey Laboratories, 1988 (Coop Education); U.S. Navy,
Electronics Technician, 1980-1985

Robert W. Sechrest is a Chemist responsible for performing inorganic and organic analysis of water, wastewater, soils, suspected hazardous waste, and building materials in accordance with approved professional and regulatory methodology. He assists with sample handling in the laboratory including reporting procedures, invoicing, designation of analysis, sample preparation, and sample preservation.

Mr. Sechrest is experienced in the operation of the atomic absorption units, UV-Visible spectrophotometer, as well as other laboratory instruments.

He is experienced with computer languages including Basic, Pascal, and Assembly.

Representative project experience includes:

Ongoing chemical analysis of samples from industry and municipalities.

Development of software programming for the manipulation of atomic absorption and gas chromatography data, report generation, sample tracking and other laboratory records.

Education: B.S. in Chemistry, Biology, Midland Lutheran College, 1987

Graduate Level coursework in Chemistry - UNL

Continuing Education: Pekin Elmer Training Seminars
- "Flame Atomic Absorption" and "Graphite Furnace Atomic Absorption"

Professional Experience: With HWS since 1988

Formerly with University of Nebraska, Teaching Assistant, Chemistry Laboratory, 1987-88

Richard Wozniak is the Analytical Laboratory Supervisor. He is responsible for performing inorganic and organic analysis of water, wastewater, soils, suspected hazardous waste, and building materials in accordance with approved professional and regulatory methodology. He assists with sample handling in the laboratory, including reporting procedures invoicing, designation of analysis, sample preparation, and sample preservation.

Mr. Wozniak is experienced in the operation of the atomic absorption units, UV-visible spectrophotometer, gas chromatograph, as well as other laboratory instruments.

Representative project experience includes:

Extensive on-site mapping of VOC's in soils using a portable gas chromatograph.

Ongoing chemical analysis of samples from industry and municipalities.

Field technician for large water sampling project in Gillette, Wyoming, for the Department of Energy.

Field technician for water sampling at various hazardous waste sites. Responsibilities included instructing clients in proper sampling procedures.

On-site technician for water quality monitoring and waste treatment of a cyanide heap leach facility spill in Idaho.

In addition, Mr. Wozniak is educated and experienced with materials and soils testing.

Education: B.S. in Agronomy, University of Nebraska, 1980
OSHA Training 20 CFR Part 1920.120(3) (40 hours)

Professional Activities: Member: American Society of
Agronomy; Weed Science Society; Range Management Society

Professional Experience: With HWS since 1983
Formerly with University of Nebraska

Quality Policy

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QUALITY POLICY

To ensure the validity of their analytical data, the HWST Analytical Laboratory personnel follow a well-balanced quality assurance (QA) program that adheres to the high standards prevailing in all aspects of the HWS consulting services.

Quality assurance in the environmental laboratory has several goals. These goals are; accuracy, precision, and completeness. The accuracy of a result reflects how close the experimental value is to the "true" value. Accuracy can be assured in running check samples of known composition both internally, within the lab and externally, by participation in round robin testing. Precision is accessed by the analysis of replicate samples. Completeness is characterized by the laboratory's ability to reproduce and to document the preparation, the analysis, the data reduction, and of custody for a set of samples.

The QA program also dictates that detailed instructions are available for performing all activities affecting the quality of analytical data. The program provides for appropriate management review and approval of all procedures, including revisions to procedures, as well as control of procedures to ensure that laboratory personnel who require specific procedures have access to them. The HWST Analytical Laboratory Procedures Manual is structured to address all elements of the quality assurance program. The basic elements of the program are described in the following paragraphs.

HANDLING OF SPECIMENS

Sample Collection

To ensure that standard and consistent methods are used to collect representative samples, the HWST QA/QC Plan begins with the sample collection process. Methods of sample collection, identification, containment and preservation are in accordance with governing Federal or State regulations. All sample collection and field analytical procedures are documented in hardback, bound field notebooks. Whenever possible, all sampling activities follow a pre-arranged Sampling and Analysis plan designed by HWST and approved by the client.

HWST personnel responsible for sample collection and field investigations are trained by experienced personnel and have access to written sampling methods. Most have completed intensive forty-hour training sessions in the sampling techniques and safety procedures approved by the USEPA for hazardous waste site investigations.

In order to demonstrate that the sampling process has produced representative samples free from cross-contamination, HWST routinely collects and analyzes duplicate samples, split samples, trip blanks, field blanks and equipment blanks. The analytical results from these field quality control samples are furnished to the client.

Whenever samples are taken from a site involved or potentially involved in litigation, the sample collector follows strict chain-of-custody protocols and initiates a chain-of-custody document which will accompany the sample until its final disposal.

Sample collection procedures are described in detail in SOP-10. Chain-of-custody procedures are described in detail in SOP-6.

Sample Transport

Because HWST itself performs most of the sampling for projects undertaken by the Analytical Laboratory, close coordination between field and laboratory personnel is possible. This minimizes the risk of analyzing samples for the wrong parameters or after the holding time has elapsed. Samples collected by HWST personnel are field preserved and returned to the laboratory for analysis as soon as possible. Laboratory personnel are notified in advance if the sample requires special treatment or immediate analysis. When personal delivery is not possible, a method of shipment is selected that ensures arrival of the sample well within the maximum holding time allowed for each analyte. Written sample transport procedures ensure that the samples are properly labeled, preserved, and protected from breakage or tampering enroute. All samples potentially involved in litigation are accompanied by a chain-of-custody document, and the sample containers and shipping container are sealed with custody tape. Sample transport procedures are described in detail in SOP 10.

Sample Receiving and Disposal

Upon arrival, all samples are inspected by the receiving agent for evidence of breakage, tampering, contamination or leakage. Sample labels are double checked against sample analysis request sheets and chain-of-custody documents. Sample preservation is checked for conformance to 40 CFR Part 136 specifications, or to the special requirements of the analytical method. If necessary, samples are split and preserved. Only after all discrepancies have been resolved and documented, is the sample logged into the Sample Logbook and given a sequentially assigned laboratory number.

If the sample is not analyzed immediately it is placed in sample storage appropriate to the sample matrix and analyses of interest. Ample locked, secure storage at 4 degrees centigrade is available for chain-of-custody samples. Maximum holding times are in accordance with USEPA regulations or as specified in the analytical method. If the holding time of an analyte is exceeded before the analysis is completed, the client is notified by the Laboratory Manager and a note included on the final report that the data may be suspect if holding times are exceeded. If available, documentation will be provided to demonstrate that the integrity of the analyte of interest has not been compromised. The essential steps of the sample receiving process are documented by the receiving agent. Samples are typically held in storage for thirty days after issuance of the report to allow the client to request additional analyses.

TEST METHODS AND PROCEDURES

The HWST QA/QC program ensures the use of methods of known accuracy and precision. Analysts are trained, evaluated and authorized by the Laboratory Manager to use the methods included in the HWST Methods Manual. Copies of these methods are kept readily available for subsequent reference by the analyst. Authorized methods include those standard methods prescribed by regulatory authorities and methods subjected to a comprehensive validation study by HWST to determine the appropriate matrix, concentration range, interferences, accuracy and precision, and safety precautions.

All major laboratory operations that affect the quality of reported results are covered by a detailed, written Standard Operating Procedure. Each analyst must learn these as part of his job training, and the primary responsibility of the analyst is to follow written methods and Standard Operating Procedures faithfully.

A bibliography of method sources maintained at HWST is contained in Appendix C.

DATA REDUCTION, VERIFICATION AND REPORTING

It is the responsibility of the analyst to record during an analysis any information necessary to reconstruct and verify the analytical procedure. This information is permanently recorded in a hardback, bound notebook issued to each analyst. In addition, bench sheets, computer or instrument printouts, chromatograms, and other ancillary data are clearly identified and permanently stored.

Data reduction is accomplished either by hand calculation clearly set up as a formula in the laboratory notebook, or by computer. Results are computed, tabulated in the laboratory notebook, and transcribed onto a computer generated worksheet. The Laboratory Manager double checks this worksheet against the analyst's notebook and any ancillary data before passing the worksheet on for report processing. To enable the report processing department to know that a report has been reviewed by laboratory management and therefore ready for printing, an initial box will be placed on the report labeled "QC reviewed". He also determines that the associated quality control data were sufficient and in control. If any discrepancies appear in the analysis, calculations, quality control or transcription, the results are held until the discrepancies are resolved or the analysis is repeated to the satisfaction of the Laboratory Manager. As a final measure, the Laboratory Manager checks the final report for accuracy, consistency and reasonableness among parameters before signing it and issuing it to the client.

The results of any analyses performed by the laboratory are furnished to the client in the form of a report which accurately, clearly and unambiguously presents the test results and any other relevant information. The standard report format clearly identifies the testing laboratory; the client, the project, the sample analyzed, the results of the analysis, and if relevant, the associated quality assurance information.

It is the policy of HWST to hold report information in strict confidence to the client. The original report is sent to the attention of the client contact person, and a file copy is retained by HWST in a secured area. Any other copies are issued only at the request of the client, and then the recipients are named on the report copy and dated. It is against the policy of HWST to discuss test results or project information with anyone other than the recognized client contact person. Access to HWST records is restricted to those authorized by the Analytical Laboratory Manager. If it becomes necessary to issue a corrected, revised or additional report, the new report is clearly identified as a replacement report and is given a new report date. All reports are signed by the Analytical Laboratory Manager, his designated representative or the Laboratory Administrative Assistant, any changes to a report can only be made by their authorization.

DIAGNOSTIC AND CORRECTIVE ACTIONS

The precision and accuracy of all measurements are routinely monitored by the inclusion of quality control samples which are analyzed and statistically evaluated.

1. At least one in ten samples analyzed for any parameter is a duplicate sample. The precision of the measuring process is evaluated by comparing the relative standard deviation (RSD) of duplicate measurements. Control limits are established at $\pm 10\%$ RSD; results showing deviations greater the 10% RSD are considered out of control and require that all samples analyzed for that parameter since the last acceptable QC result be re-analyzed.
2. At least one in ten samples analyzed for any parameter is a quality control sample evaluated for accuracy. This may be any one or more of the following:
 - a. A matrix-spiked sample - a background split from the sample is analyzed simultaneously with another split which has been spiked with a known quantity of the analyte of interest. The percent recovery of the added spike is calculated by comparison of the background with the spiked sample. Control limits are set at 90% - 110% recovery. Spike recoveries outside of these limits require repeating the analysis until recovery is in control, or use of the method of standard additions to account for matrix affects.
 - b. A spiked blank - an aliquot of reagent grade water is spiked with a known quantity of the analyte of interest and analyzed. The percent recovery of the analyte must be within the control limits of 90% - 110% recovery or the analysis is repeated.
 - c. A known, independently verified check sample - the sample is analyzed and the result compared to the true value. Control limits are set at \pm three standard deviations from the true value. Results outside of these limits require repetition of all analyses performed for that analyte since the last acceptable QC result.
3. When new lots of reagents or solvents are used, or as required by the analytical method, reagent blanks are analyzed to demonstrate freedom from contamination by reagents, glassware or poor analytical technique.
4. These quality control measures are in addition to quality control samples taken as a check on sample collection and transport procedures.
5. These are the laboratory's minimum quality control measures used to routinely monitor the accuracy and precision of analytical

procedures; if written methods demand a higher frequency of quality control samples or more stringent measures, the laboratory will follow the requirements of the method.

6. Any failure to meet the established criteria for a quality control measurement is viewed as a warning that the measurement is out of control. Further analysis and reporting of data is stopped, the Laboratory Manager is notified, and a written quality control irregularity report is initiated. After the problem has been identified and corrected, additional quality control samples are analyzed to ensure that the system is back in control before resuming analysis, also the manager will then review the irregularity report and initialize it showing that the failure and corrective action have been disclosed to and understood by the manager before resuming analysis. All samples analyzed after the last acceptable quality control result are re-analyzed. A file of quality control irregularity reports and corrective actions taken is maintained by the Laboratory Manager.
7. Standard Operating Procedures 11 and 12 cover Diagnostic and Corrective Actions.

EXTERNAL PERFORMANCE EVALUATIONS AND CERTIFICATIONS

In addition to a routine internal Quality Control program, HWST participates in a variety of programs conducted independently by outside services. These serve as an additional check on the accuracy and precision of the laboratory's operations. They include Performance Evaluations based on the analysis of unknown samples, and performance audits leading to certification by independent authorities.

1. United States Environmental Protection Agency

a. National Pollutant Discharge Elimination System (NPDES) Program.

An annual analysis of wastewater quality control samples for biochemical oxygen demand, chemical oxygen demand, ammonia as nitrogen, total kjeldahl nitrogen, phosphorous, oil and grease, pH, suspended solids, nitrate-nitrogen, cyanide, phenolics, orthophosphate, aluminum, arsenic, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, vanadium, zinc.

b. Water Supply Performance Evaluation Study.

A biannual analysis of drinking water quality control samples for cyanide, sulfate, sodium, alkalinity, pH, calcium hardness, total filterable residue, turbidity, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, selenium, silver, nitrate-nitrogen, nitrite-nitrogen, fluoride.

c. Water Pollution Performance Evaluation Study.

A biannual analysis of general water quality and water pollution quality control samples for oil and grease, phenolics, cyanide, non-filterable residue, 1,2-dichloroethane, chloroform, 1,1,1-trichloroethane, trichloroethene, carbontetrachloride, tetrachloroethene, bromodichloromethane, dibromochloromethane, bromoform, methylene chloride, chlorobenzene, benzene, ethylbenzene, toluene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, chemical oxygen demand, biochemical oxygen demand, ammonia-nitrogen, nitrate-nitrogen, orthophosphate, total kjeldahl nitrogen, phosphorus, alkalinity, chloride, fluoride, sulfate, pH, specific conductance, total dissolved solids, total hardness, calcium, magnesium, sodium, potassium, aluminum, arsenic, beryllium, cadmium, cobalt, chromium, copper, iron, mercury, manganese, nickel, lead, selenium, zinc, antimony, silver.

The laboratory follows standard operating procedures for recordkeeping that ensure a complete, permanent and easily retrievable means to verify all aspects of sample and data management. Permanent, secure storage is maintained for all original observations, calculations and derived data, calibration records and final test reports. A complete description of the files maintained and their location is found in S.O.P.'s 1, 2, 6, 7 and 13.

UPDATING AND CONTROL OF DOCUMENTS AFFECTING QUALITY

The Laboratory Manager is responsible for the annual review of the Quality Assurance Manual (January 31), Standard Operating Procedures Manual (February 28), and HWST Methods Manual (March 31). The addition of new methods or procedures and revision or correction of material is done under the direction and approval of the manager. When changes are made, they will be made only on the appropriate pages and the pages will be dated to indicate the new effective date.

The quality system review will include documenting the review as well as documenting any corrective action. The review will be conducted by the Laboratory Quality Control Officer with a written report to management including the First Vice President of HWS Technologies Inc.

SUBCONTRACTING

Subcontracting

Projects undertaken by HWST will occasionally include an analysis not normally performed by the HWST Analytical Laboratory if this occurs it is standard procedure to disclose all subcontractors used in our laboratory report. If it is necessary to lease equipment for the analysis or subcontract the work out to another laboratory, procedures are followed to ensure that the analysis is conducted to HWST's own high standard.

Equipment is leased from established, reputable firms that can provide HWST with documentation of proper equipment maintenance and manuals covering calibration, operation and troubleshooting of the equipment. Leased instruments are calibrated by HWST personnel with standard materials as required by the analytical method, and proper function is demonstrated by successful analysis of quality control samples before unknown test samples are analyzed.

In selecting an outside laboratory for subcontracting, strong preference is given to established laboratories with appropriate government certification or nationally recognized accreditation. HWST requires that the analytical data furnished by the subcontractor include all the information provided on each HWST test report. This includes a unique sample identification, the method used, the limits of detection, the date analyzed, and the signature of the person accepting technical responsibility for the analysis.

4.2.4 Technical Complaint Handling Procedure.

The following procedure will be inserted into the HWST Quality Assurance Manual:

Always handle client requests promptly. Accept client complaints with patience, and quietly and courteously make a full and satisfactory explanation, exercising tact at all times. In the instance of a technical complaint, laboratory personnel or the QA officer will conduct a review of the report package including bench sheets associated with the samples involved to determine if the report is validated by information in the data package. Report to client if data is or is not validated by review and reason if it is not. This Technical Complaint Report will be at least documented in our own separate file and sent to the client if an explanation is needed or required. Corrective action will follow.

APPENDICES

- Appendix A: Analytical Procedures for Lockwood**
- Appendix B: QC Documents Referenced**
- Appendix C: Index of Testing Documents**
- Appendix D: Index of Equipment Used**

APPENDIX A
ANALYTICAL PROCEDURES
FOR LOCKWOOD

Analytical Procedures

Parameter	Technique ¹	<u>Extraction and Analysis Method²</u>		<u>Detection Limit</u>	
		Water	Soil/Sediment	Water (mg/L)	Soil/Sediment (mg/Kg)
Volatile Organics	GC/MS	8240	8240	Table 6.4	Table 1.0
Arsenic	GFAA	3020/7060	3050/7060	0.005	0.25
Cadmium	GFAA	3020/7131	3050/7130	0.005	0.50
Chromium	GFAA	3020/7191	3050/7190	0.005	2.5
Lead	GFAA	3020/7421	3050/7420	0.005	5.0
Zinc	FLAA	3005/7950	3050/7950	0.01	0.5

¹ GC/MS = gas chromatography/mass spectrometry, GFAA = graphite furnace atomic absorption, FLAA = flame atomic absorption

² Methods are from "Test Methods for Evaluating Solid Waste" SW-846 Third Edition

Table Continued
Analytical Quality Control Samples
(Water and Soil)

Parameters	QC Measure	Frequency	Control Limits
	Initial and Continuing Calibration	Daily and each instrument setup	within 20% of true value
	Matrix Spike Analysis	One per analytical batch	MS/MSD 1,1 Dichloroethane 61-145% recovery, Benzene 76-127% recovery, Trichloroethane 71-120% recovery, toluene 76-125% recovery, chlorobenzene 75-130% recovery
	Matrix Spike Duplicate Analysis	One per analytical batch	
	Surrogate Spike	Each sample where appropriate	SS, Toluene - d8, 81-117% recovery, bromofluorobenzene 74-121% recovery, 1,2 Dichloroethane - d4, 70-121% recovery
Notes	¹ An analytical batch consists of 20 samples or less, prepared or analyzed together with a common QC sample. A case consists of one or more Sample Delivery Groups.		

Analytical Quality Control Samples
(Water and Soil)

Parameters	QC Measure	Frequency	Control Limits
Metals (As, Cd, Cr, Pb, Zn)	Calibration Blank	Each calibration, beginning and end of each run, 10% frequency	less than detection limit
	Initial Calibration Verification	Daily for each instrument setup	within 10% of true value
	Continuing Calibration Verification	Beginning and end of each run; 10% frequency or every 2 hours.	within 20% of true value
	Preparation Blank	One per analytical ¹ batch	less than two times
	Matrix Spike Analysis	One per analytical batch	within 15% of true value
	Duplicate Sample Analysis	One per case or one per 10 samples	within 20% relative percent difference
	Laboratory QC Sample Analysis	One per analytical batch	within 20% of true value
	Analytical Spike	Each sample (at least a single analytical spike will be performed to determine if the method of standard addition is required for quantitation)	within 15% of true value
Volatile Organic Compounds/	Laboratory Blank	One per analytical batch	less than detection limit, except acetone and methylene chloride which are less than 5 times detection limit

ANALYTICAL INSTRUMENTS USED FOR METAL ANALYSIS

Parameter	Analytical Instrument	Analytical Method
Arsenic	Perkin-Elmer A.A. 2100-HGA 700	Graphite Furnace - Atomic Absorption
Barium	Perkin-Elmer A.A. 2100	Direct Flame - Atomic Absorption
Cadmium	Perkin-Elmer A.A. 2100	Graphite Furnace - Atomic Absorption
Chromium	Perkin-Elmer A.A. 2100	Graphite Furnace - Atomic Absorption
Iron	Perkin-Elmer A.A. 2100	Direct Flame - Atomic Absorption
Lead	Perkin-Elmer A.A. 2100	Graphite Furnace - Atomic Absorption
Selenium	Perkin-Elmer A.A. 2100-HGA 700	Graphite Furnace - Atomic Absorption
Zinc	Perkin-Elmer A.A. 2100	Direct Flame - Atomic Absorption
Silver	Perkin-Elmer A.A. 2100	Direct Flame - Atomic Absorption
Mercury	Perkin-Elmer A.A. 2100 Varian VGA-76	Vapor Generation - Atomic Absorption

Parameter	Container	Preservative	Sample Volume	Maximum Holding Time	Method	Detection Limit	Analytical Instrument
pH	Plastic		Field Determination		150.1*	Range 4.0-10.0	Orion Model 701A
Specific	Plastic		Field Determination		120.1*	Range 0.1-20,000	VWR Scientific Conductance Model 604

* "Methods for Chemical Analysis of Waste and Wastes", EPA 600/4-79-20.

** Standard Methods for the Examination of Water and Wastewater, 16th Ed., APHA-AWWA-WPCF.

RCRA METALS (Total)

Parameter	Container	Preservative	Sample Volume	Maximum Holding Time	Analysis Method	mg/L Detection Limit
Arsenic	Plastic	< 2pH; HNO ₃	1 liter	6 months	206.2 ¹	0.005
Iron	Plastic	< 2pH; HNO ₃	1 liter	6 months	236.1 ²	0.1
Lead	Plastic	< 2pH; HNO ₃	1 liter	6 months	239.2 ⁴	0.005
Manganese	Plastic	< 2pH; HNO ₃	1 liter	6 months	243.1 ²	0.01
Zinc	Plastic	< 2pH; HNO ₃	1 liter	6 months	289.1 ²	0.01
Silver	Plastic	< 2pH; HNO ₃	1 liter	6 months	272.1 ²	0.01
Mercury	Plastic	< 2pH; HNO ₃	1 liter	28 days	245.1 ³	0.0005
Barium	Plastic	< 2pH; HNO ₃	1 liter	6 months	208.1 ²	0.1
Cadmium	Plastic	< 2pH; HNO ₃	1 liter	6 months	213.2 ⁴	0.005
Chromium	Plastic	< 2pH; HNO ₃	1 liter	6 months	218.2 ⁴	0.005
Selenium	Plastic	< 2pH; HNO ₃	1 liter	6 months	270.2 ⁴	0.005

¹Acid Digestion Method 7060

²Acid Digestion Method 3010

³Acid Digestion Method 7470

⁴Acid Digestion Method 3020

<u>Parameter</u>	<u>Sample Containers</u>	<u>Volume Req'd.</u>	<u>Preservative</u>
Volatile Organics, Water	2-40 ml vials with Teflon-lined septa	40 ml	4°C
Volatile Organics, Soil	2-40 ml vials with	10g	4°C
Metals (As,Cd,Cr,Pb,Zn) Water	1-1L plastic bottle	1000ml	4°C and HNO ₃ to pH <2
Metals (As,Cd,Cr,Pb,Zn) Soil	1-8 oz. wide mouth glass jar	50g	4°C

APPENDIX B

QC DOCUMENTS REFERENCED

Federal Register: Part III 40 CFR Parts 160 and 792; "Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and Toxic Substances Control Act (TSCA); Good Laboratory Practice Standards; Proposed Rules", December 28, 1987.

"Guidelines and Specifications for Preparing Quality Assurance Program Plans", QAMS-004/80, U.S. Environmental Protection Agency, Washington, DC, September 20, 1980.

"Handbook For Analytical Quality Control In Water and Waste Water Laboratories", EPA 600/4-79-019, U.S. Environmental Protection Agency, March 1979.

"Interim Guidance on Preparing Revised Quality Assurance Program Plans", QAMS - 005/80, U.S. Environmental Protection Agency, May 20, 1985.

"Manual for the Certification of Laboratories Analyzing Drinking Water: Criteria and Procedures/Quality Assurance", EPA 570/9-82-002, U.S. Environmental Protection Agency, October 1982.

"QA: Quality Assurance Handbook", Center For Analytical Chemistry, National Bureau of Standards, U.S. Department of Commerce, November 20, 1987.

"Quality Assurance: A Laboratory Management Practice Manual", American Council of Independent Laboratories, Inc., May, 1986.

"Standards for the Certification and Approval of Environmental Analytical Laboratories", State of Kansas, Department of Health and Environment, January, 1983.

APPENDIX B, CONTINUED

"RCRA Groundwater Monitoring Technical Enforcement Guidance Document", U.S. EPA Office of Solid Waste and Environmental Response, Washington, DC, September, 1986, OSWER - 9950.1.

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition, Volume One, Section A, Chapter 1, U.S. EPA Office of Solid Waste and Emergency Response, September, 1986.

J.K. Taylor and T.W. Stanley, Editors, "Quality Assurance for Environmental Measurements", ASTM STP 867, American Society for Testing and Materials, Philadelphia, 1985.

Cory L. Perket, Editor, "Quality Control in Remedial Site Investigation: Hazardous and Industrial Solid Waste Testing", ASTM STP 925, American Society for Testing and Materials, Philadelphia, 1985.

"Standard Guide for Evaluating Laboratories Engaged in Sampling and Analysis of Water and Wastewater", ASTM D3856-80, American Society for Testing and Materials, Philadelphia, 1980.

APPENDIX C

INDEX TO TESTING DOCUMENTS

- A. Sample(s) collection technique, sample container(s), sample size, sample preservation and physical/chemical analyses were performed in accordance with
- B. Sample(s) analyzed as received in accordance with
 1. "Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-20.
 2. Standard Methods for the Examination of Water and Wastewater, 16th Ed., APHA-AWWA-WPCF.
 3. "Test Methods for Evaluating Solid Waste", EPA SW-846.
 4. "The Analysis of Trihalomethanes in Drinking Water by Liquid-Liquid Extraction, EPA Method 501.2," November 6, 1979.
 5. Official Methods of Analysis, 14th Ed., A.O.A.C.
 6. Methods of Soil Analysis, Part 2, American Society of Agronomy.
 7. Water and Environmental Technology, Annual Book of ASTM Standards, 1986.
 8. "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", EPA 600/4-82-057.
 9. "Test Methods for the Determination of Polychlorinated Biphenyls in Transformer Fluid and Waste Oils," EPA 600/4-81-045.
 10. EPA Contract Laboratory Program, Statement of Work for Organic Analysis, 1984, amended, 1985.
 11. procedures contained in Federal Register, Vol. 47, No. 4, January 7, 1982
 12. NIOSH Manual of Analytical Methods, 2nd Ed., U.S. Department of Health, Education and Welfare, Publ. (NIOSH) 77-157 A-B-C (1977).
 13. "Information Document on Gasohol" contained in Petroleum Products, Lubricants and Fossil Fuels, Annual Book of ASTM Standards, 1984.
 14. Petroleum Products and Lubricants, Annual Book of ASTM Standards, 1987.
 15. Uniform Building Code Standard No. 43-8, "Thickness and Density Determination for Spray-Applied Fireproofing," 1979 Edition.
 16. Note: This solid sample did not exhibit the hazardous characteristic of ignitability when tested in accordance with EPA SW 846 Volume One, Section C, Part II, Chapter Seven, Paragraph 7.1.2.2.

APPENDIX C continued

Index to Test Methods

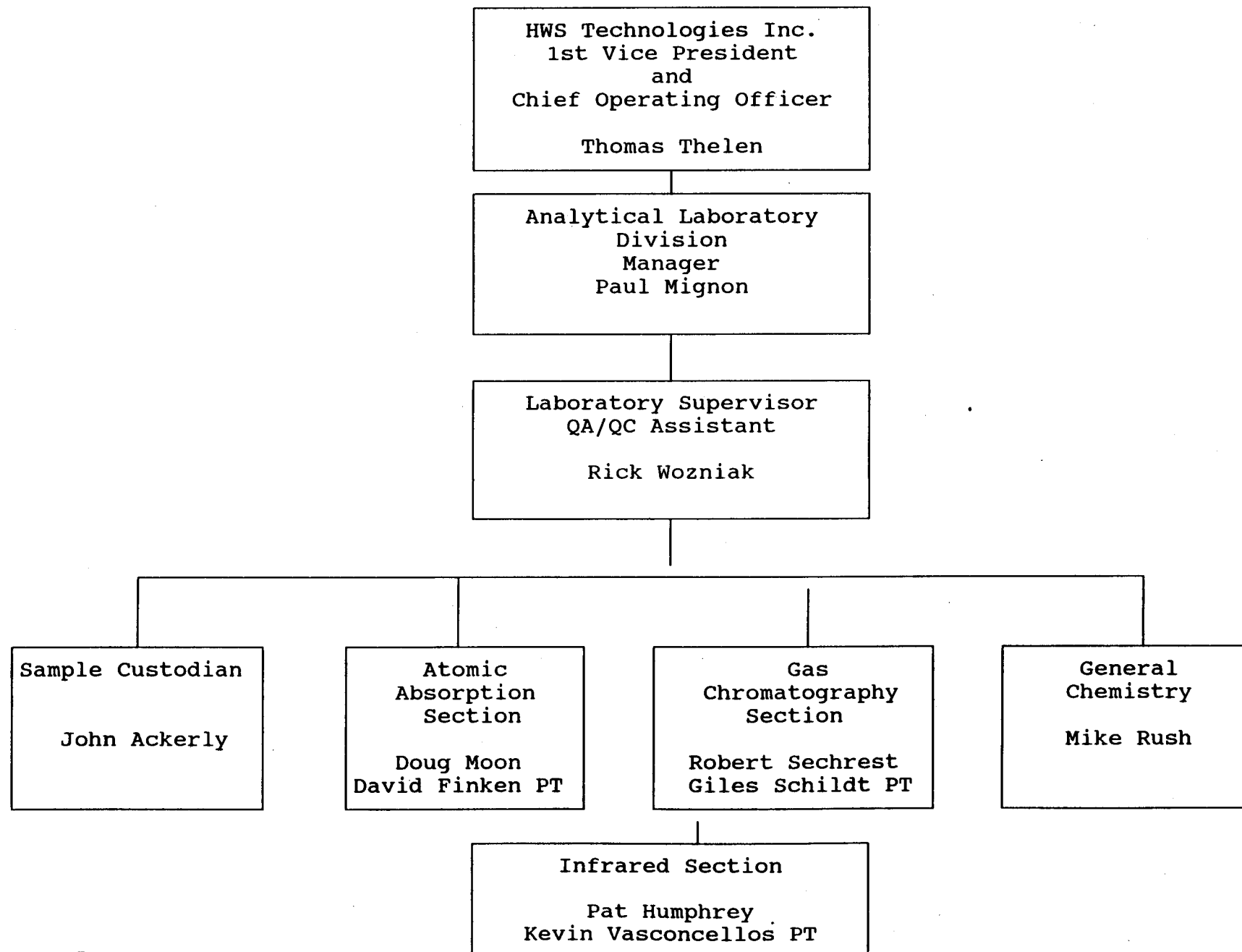
1. Methods prescribed by B. Bunn (EPA Region VII) to P. Mignon (HWST) on February 7, 1986.
2. Methodology developed by HWS Technologies Inc.
HWS Technologies Inc. Standard Methods Manual

APPENDIX D

MAJOR LABORATORY AND FIELD EQUIPMENT

Instrument	Manufacturer/Model	HWS #	Serial #
Atomic Absorption Spectrophotometer	Perkin-Elmer 2100		1609922176
Atomic Absorption/Autosampler	Perkin-Elmer AS-70		128581
Atomic Absorption Controller Assembly:	EPSON/EX-800		03017001
	EPSON/Equity-II+		MB80211693
	EPSON/MBM-2095E		14574-A51
	Cherry Keyboard		160604 8080
Atomic Absorption/Graphite Furnace	Perkin-Elmer HGA-700		
Atomic Absorption/Recorder	Perkin-Elmer 023	00154	
Atomic Absorption/Vapor Generator	Varian/VGA-76	01646	703 2501
Atomic Absorption/Vapor Generator	Varian/VGA-65		
Balance, Analytical Electronic	American Scientific Prod/SP180		2901139 B1240-1
	Voland Co./220R		
	Mettler/H-80	00013	
Balance, Top-loading Electronic	OHAUS/300	00125	1382
Balance, Triple-beam	OHAUS/2610G	00152	
Calorimeter, Oxygen Bomb	Parr/1341	00473	4352
Conductivity Meter	Chemtrix, Inc./700	00023	1019
Conductivity Meter	Cole Parmer/		
Dissolved Oxygen Probe	Orion/97-08-00		
Extraction Unit, E.P. Toxicity			
Gas Chromatograph	Varian/Series 3700	000153	74030517-13
Gas Chromatograph	Varian/Series 3300	01710	4279
Gas Chromatograph/Purge & Trap	Tekmar/LSC 2	00488	1243
Gas Chromatograph/Purge & Trap	Tekmar/LSC 2000		88298008
38298008			
Gas Chromatograph/Integrator	Varian/4270	01711	057/25189
Heater, Multi-block	Lab Line/2090	00419	
Hood, Fume	LabConco/59006		
Incubator			
Ion Specific Electrodes			
Digital pH, mV Meter	Orion Research/EA 920		PU 83A
Digital pH, mV Meter	Orion Research/701A	00008	57698
pH, mV Meter	Chemtrix/60A	00286	1028
pH Meter, Portable	Beckman	1502	
Furnace, Muffle	Thermolyne/1500 FD1525M	00012	135 364
(2) Organic Photoionization Detector	HNU/HW101		
	HNU/HW101		
(2) Organic Photoionization Detector	HNU PI101	00402	41670
	HNU PI101		
(2) Oven, Drying	Soil Test/L-5B		608692
	Soil Test/L-5B		608693
Refrigerator/Freezer			
Refrigerator/Freezer			
Refrigerator/Freezer			
Sampling Equipment:	Hotpoint/20 T-13		C-WZ145120
Composite Sampler	ISCO/1392	01496	
Flow Recorder	Stevens/	01497	
Flow Recorder	Stevens/	01498	
Well Samplers:			
2-inch Well Sampler	ISCO/2600	00191	
3-inch Submersible Pump	Standard	01499	
4-inch Submersible Pump	Grundos	01500	
Shaker, Orbital	Labline/3520	00190	
Spectrophotometer/UV/Visble	Bausch & Lomb/Spectronic 21	00014	0402602
	Bausch & Lomb/Spectronic 20		33-29-61-62
	Magniwhirl/MW-1130A		M5-18130
Water Bath, Constant Temperature	Barnstead/Thermolyne/D4751	55000318	
Water Purifier, Nanopure			

HWS TECHNOLOGIES INC. ANALYTICAL LABORATORY
ORGANIZATIONAL CHART



APPENDIX E

MONITORING WELL DATA

TABLE VB1-1 TABULATED WELL DATA FOR LOCKWOOD

WELL NUMBER	ELEV. CASING	ELEV. GROUND	SCREENED INTERVAL	CASED INTERVAL	PIPE SIZE ID	DATE DRILLED	DRILLING COMPANY	CONSULTING COMPANY	DRILLING METHOD	DEPTH BOTTOM Nov-89	DEPTH WATER Nov-89
MW-1	80.18	78.6	65.26 - 55.26	80.18 - 65.26	4 INCH	10/9/85	NELSON	HWS TECH.	ROTARY	24.79	8.97
MW-2	79.89	78.4	60.55 - 50.55	79.89 - 60.72	4 INCH	10/10/85	NELSON	HWS TECH.	ROTARY	30.09	8.71
MW-3	81.02	79.5	62.52 - 52.52	81.02 - 62.69	4 INCH	10/10/85	NELSON	HWS TECH.	ROTARY	28.54	9.52
MW-4	80.28	78.8	63.03 - 53.03	80.28 - 62.86	4 INCH	10/9/85	NELSON	HWS TECH.	ROTARY	27.52	9.34
MW-5	80.63	79.2	64.47 - 54.47	80.63 - 64.13	4 INCH	10/9/85	NELSON	HWS TECH.	ROTARY	26.06	9.86
MW-6	80.73	78.9	60.23 - 50.23	80.73 - 60.23	4 INCH	10/7/85	NELSON	HWS TECH.	ROTARY	29.61	9.02
MW-7	80.46	79	61.71 - 51.71	80.46 - 61.71	4 INCH	10/8/85	NELSON	HWS TECH.	ROTARY	28.19	9.33
MW-8	81.45	79.7	61.95 - 51.95	81.45 - 61.95	4 INCH	10/10/85	NELSON	HWS TECH.	ROTARY	29.56	9.59
MI-1	79.11	78.9	64.61 - 54.61	79.11 - 64.61	6 INCH	10/9/85	NELSON	HWS TECH.	ROTARY	24.14	
MI-2	80.06	78.8	61.39 - 51.39	80.06 - 61.39	6 INCH	10/7/85	NELSON	HWS TECH.	ROTARY	27.16	8.35
LW-1	88.01	85.8	54.77 - 44.77	88.00 - 54.77	2 INCH	11/1/89	NELSON	WTR. & AIR	ROTARY	42.2	18.98
LW-2	87.58	85.9	70.42 - 50.42	87.58 - 70.42	2 INCH	11/1/89	NELSON	WTR. & AIR	ROTARY	36.8	17.71
LW-3	87.79	85.7	70.26 - 60.26	87.79 - 70.26	2 INCH	11/2/89	NELSON	WTR. & AIR	ROTARY	26.95	18.55
LW-4	81.78	79.2	63.97 - 53.97	81.78 - 63.97	2 INCH	11/2/89	NELSON	WTR. & AIR	ROTARY	22.87	12.64
LW-5	86.61	84.6	69.32 - 59.32	86.61 - 69.32	2 INCH	11/2/89	NELSON	WTR. & AIR	ROTARY	27.29	16.64
LW-6	75.85	84.9	UNKNOWN	UNKNOWN				UNKNOWN	UNKNOWN		
LW-7					2 INCH		PANHANDLE	WTR. & AIR	HOLLOW STEM	29.72	17.33
LW-8					2 INCH		PANHANDLE	WTR. & AIR	HOLLOW STEM	33.91	19.71

North side
Top of 30'
casing

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Dodge City, KS 67801
(316) 225-6201



TITAN INDUSTRIES, INC.

Water Well Supply Division

FOUR SQUARE THREADED PVC FLUSH JOINT

Effective: November 1, 1989

Replaces: October 1, 1988

Page 1 of 5

Most lengths noted are actual made up lengths.* Lengths Other Than Those Noted and some Specialty Fabrication are produced on request. Please call 1-800-247-6167, Ext. 755 or Ext. 922 for price and availability.

*For sizes 4½" & larger, every effort will be made to provide setting lengths. However, due to the lead times required to have PVC extruded in longer than standard lengths, sometimes we may have to provide overall lengths. When this is required, we will advise you prior to shipment of your order.

Select From Two (2) Screen Options:

Standard Flush Joint Screen** (1/4" distance between slots) is available for 1/2" through 10" diameters. We produce .010", .012", .016", .018", .020", .025", .032", .040", .050", and .060" slot sizes for all diameters EXCEPT in 8" and 10". 8" & 10" Sch. 40 are available in .016" and larger slot sizes. 8" & 10" Sch. 80 can be produced in .025" and larger slot sizes at the present time.

Hi-Flo Flush Joint Screen*** (1/8" distance between slots) is available for 1/2" through 10" diameters. Hi-Flo slot size alternatives are .010", .012", .016", .018", and .020" (8" & 10" not available in .010" & .012" sizes). Hi-Flo Screens Are Not available in Sch. 80 in 4" & larger.

**The Standard number of rows of slots in the screen are as noted below. (Additional rows are available at a slight additional charge. Please inquire as to price & availability.)

2 Rows -- 1/2", 3/4", 1", 1 1/4", 1 1/2"
3 Rows -- 2", 2 1/2", 3"
4 Rows -- 4", 4 1/2", 5"

5 Rows -- 6"
6 Rows -- 8"
8 Rows -- 10"

***The number of rows of slots in the Hi-Flo Screens are the same as the above. However, given the high amount of surface area slotted with the 1/8" spacing, for the sake of strength we caution against the addition of more rows than the above.

NOTE: We can also slot a portion of a length of PVC Flush Joint, for example the bottom 5 ft. or 10 ft., while leaving the top portion as casing. We can likewise leave a portion of blank material on the bottom to serve as a sump. Pricing on alternatives such as this depends upon quantity, slot size, length of screen portion, etc. Other lengths or special fabrication can be produced on request.

Special detergent rinses, bagging, wrapping or other optional packaging can be supplied, if required. Most sizes can be produced with threads conforming to ASTM standard F480-88a. Call 1-800-247-6167, Ext. 755 Or Ext. 922 For Price & Availability For Any Requirements Not Shown Herein.

Continued on Page 2

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Titan Four Square Flush Joint Monitor Pipe & Screen

Titan Industries' Four Square Flush Joint Monitor Pipe & Screens provides to the monitoring and water well industry a sanitary, seal tight, yet simple and affordable joint. We offer **MORE** diameters, schedules and other alternatives than ever before.

The precise square cut threads insure a perfect and near solid joint every time. An optional feature for a guaranteed watertight, airtight connection is a flat neoprene sealer ring.

All Titan Four Square Flush Joints are manufactured from NSF approved polyvinyl chloride (PVC) materials that meet or exceed all ASTM Schedule 40, Schedule 80, and F-480 specifications. Other materials, such as SDR 21, SDR 17, &/or other schedules and specifications are available in many sizes upon special order.

Each and every Four Square Joint is produced on machines of latest technology. A meticulous check of each joint by our stringent quality control personnel insures thread accuracy and fit-ability making field installation as simple and fast as possible.

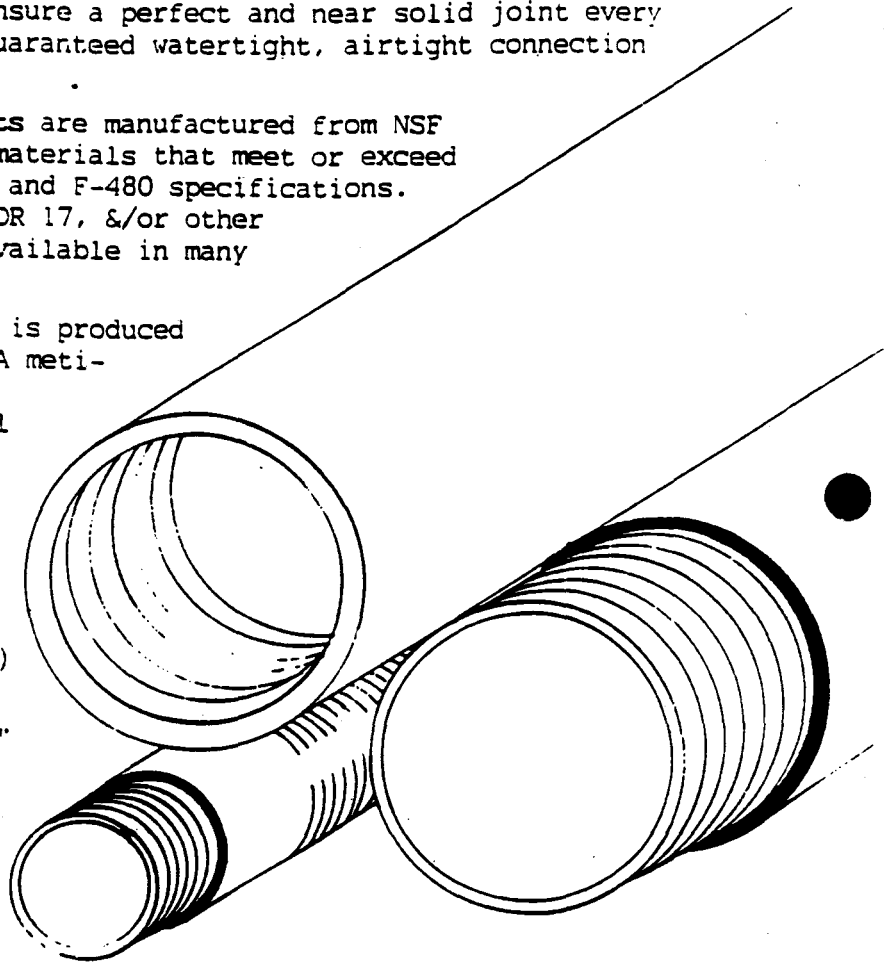
Screens and Casings are available in sizes ranging from 1/2" Sch. 80 through 10" Sch. 80. Our Standard Screen (1/4" slot spacing) is available for all diameters.

Our new Hi-Flo Screens, with 1/8" spacing between slots, provides the answer to those applications that require additional screen open area. Hi-Flo Screens are available in 1/2" thru 8" (Except in 4" - 8" Sch. 80 and in 4 1/2" and larger SDR 17).

Casing and screen bodies are stock lengths of 2 - 5 - 10 or 20'. Special lengths, when required, and a variety of slot sizes ranging from .010" and larger make Titan Four Square Flush Joint Casings & Screens the contractor's and engineer's choice for monitoring, recovery, de-watering, and many other water well applications.

Titan has the flexibility and ability to also do special design and construction for the uncommon job.

For the complete Four Square story, contact Titan Industries, Paxton, Nebraska, U.S.A. TOLL FREE 1-800-247-6167, Extension 755.



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Titan Industries' Four Square Flush Joint Monitor Pipe & Screens provides to the monitoring and water well industry a sanitary, seal tight, yet simple and affordable joint. We offer MORE diameters, schedules and other alternatives than ever before.

The precise square cut threads insure a perfect and near solid joint every time. An optional feature for a guaranteed watertight, airtight connection is a flat neoprene sealer ring.

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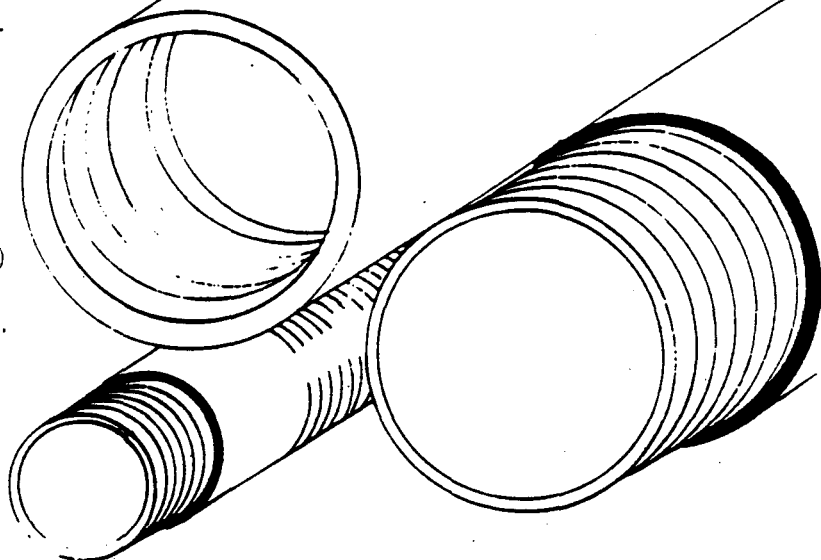
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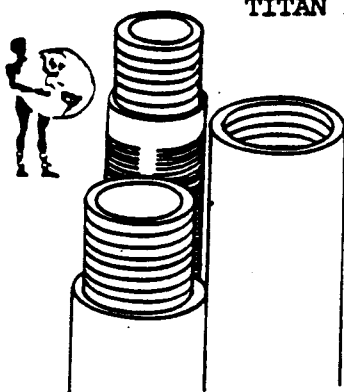
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MONITORING PRODUCTS**



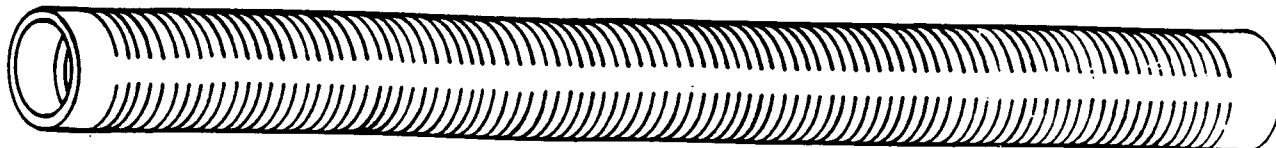
TITAN INDUSTRIES FOUR SQUARE MONITORING SCREENS & RISER

- .PVC - Schedule 40, SDR 17, & Schedule 80
1/2" through 10" Flush Joint
- .Stainless Steel - #304 & #316 in 2", 4", 6"
- .Teflon
- .Fiberglass
- .Low Carbon Mild Steel
- .1/4", 3/8", 1/2" Bentonite Pellets
Bagged Bentonite, VolClay Grout
- .Colorado Silica Sand
- .Bailers, Centralizers, Protective Enclosures,
Manhole Covers, Hazardous Waste Barrels,
Misc. Accessories



TITAN INDUSTRIES EASY-FLO SLOTTED PVC SCREENS (1/4" SPACING)

- 1/2" through 48" — Belled End &/or Plain End
- .010" and larger slot sizes
- Virtually all Schedules & Classes, including Sch. 40,
Sch. 80, SDR 26, SDR 21, SDR 17



TITAN INDUSTRIES HI-FLO SLOTTED PVC SCREENS (1/8" SPACING)

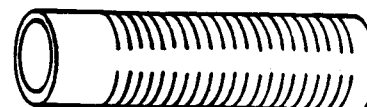
- 1/2" through 10" — Belled End &/or Plain End
- .010", .012", .016", .018", .020" slot sizes
- Schedule 40, SDR 21, Sch. 80 in Most Diameters

TITAN INDUSTRIES SURE-DRAIN PVC DRAINAGE PIPE

- Virtually Any Diameter & Schedule From 1/2" & Upward



Round Holed Openings 3/16"
Through 1" Diameter



Rectangular Openings From .010"
Through .120" Slot Widths



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- Sch. 80 PVC Drop Pipe
(Threaded Both Ends)

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APPENDIX F

**SITE HEALTH AND
SAFETY PLAN**

RCRA FACILITY INVESTIGATION

HEALTH AND SAFETY PLAN

LOCKWOOD CORPORATION

GERING, NEBRASKA

Part V.B.1.d.

January 1990

Prepared by

**HWS TECHNOLOGIES INC.
825 J Street
Lincoln, Nebraska 68508**

HWS TECHNOLOGIES INC.
HEALTH AND SAFETY PLAN

PROJECT NAME: Lockwood Corporation
PROJECT NUMBER: 72-57-5002.00
PROJECT SITE LOCATION: Lockwood Corporation
Gering, Nebraska
PROJECT MANAGER: Erwin Kirkvold
SAFETY COORDINATOR: Ron Sorensen
SITE SAFETY OFFICER: To Be Assigned

APPROVED BY:

Project Manager

Date

Safety Coordinator

Date

Site Safety Officer

Date

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FIGURE 3

FIGURE 14.1 - DECONTAMINATION LAYOUT

FIGURE 14.1.6 - DECONTAMINATION LAYOUT

FIGURE 14.2 - DECISION AID FOR EMERGENCY DECONTAMINATION

FIGURE 17.1 - EMERGENCY ROUTE MAP TO MEDICAL CENTER

TABLE 1 - KNOWN SITE CONTAMINANT SUMMARY

TABLE 2 - PERMISSIBLE NOISE EXPOSURES

TABLE 3 - ENVIRONMENTAL MONITORING

APPENDIX A - DOCUMENTATION

APPENDIX B - RESPIRATOR FITTING METHODS

1.0 PURPOSE

1.1 This plan provides health and safety guidelines for anticipated surface and underground operations conducted by HWS Technologies Inc. (HWST) employees during work activities at the Lockwood Corporation facility in Gering, Nebraska. It is HWST's policy to comply with all governmental regulations and requirements related to the environment and employee health and safety. Because it is not feasible to describe all possible hazards or all necessary precautions in a dynamic operation of this nature, this plan addresses only those fundamental issues of known concern. It is the responsibility of all field team members to evaluate the work conditions of each site and, if in doubt about the safety of an operation, request assistance from the Site Safety Officer. This plan will be updated or revised as necessary.

Compliance with this plan is mandatory for all on-site HWST employees.

2.0 RESPONSIBILITIES

2.1 The Project Manager's responsibilities include:

- ♦ Making certain that personnel receive this plan and are aware of the provisions of this plan, are instructed in the work practices necessary to ensure safety, and are familiar with planned procedures for dealing with emergencies.
- ♦ Assuring the completion of Plan Acceptance Forms.

- ♦ Making certain all field personnel have had hazardous waste worker health and safety training per 29 CFR 1910.120.
- ♦ Making certain that personnel are aware of the potential hazards associated with site operations.
- ♦ Obtaining permission for site access and coordinating activities with appropriate personnel.
- ♦ Correcting any work practices or conditions that may result in injury or exposure to hazardous substances.
- ♦ Preparing any accident reports and routine job exposure forms (see Appendix A - Accident Report and Exposure History Forms).

2.2 The Site Safety Officer's responsibilities include:

- ♦ Implementing the project Health and Safety Plan, reporting to the Safety Coordinator and the Project Manager for action if there are any deviations from the anticipated conditions described in the plan, and having the authorization to stop work at any time.
- ♦ Conducting periodic inspections to determine if the Health and Safety Plan is being followed.
- ♦ Controlling entry and exit at Access Control Points.
- ♦ Monitoring on-site hazards and conditions.
- ♦ Calibrating all monitoring equipment on a daily basis and recording results on the appropriate sheets (see Appendix A - Instrument Calibration Check and Environmental Monitoring Sheets).

- ♦ Making certain that all monitoring equipment is operating correctly according to manufacturer's instructions and providing maintenance if it is not.
- ♦ Selecting protective clothing and equipment.
- ♦ Periodically inspecting protective clothing and equipment.
- ♦ Ensuring that protective clothing and equipment are properly stored and maintained.
- ♦ Monitoring on-site project personnel for signs of stress such as cold exposure, heat stress, and fatigue.
- ♦ Assuring proper health and safety training of all HWST field staff.
- ♦ Defining limited access zones on a daily basis.
- ♦ Coordinating emergency care, evaluation, rescue, etc.
- ♦ Enforcing the "buddy" system.
- ♦ Enforcing the Health and Safety Plan on-site.

2.3 Project Personnel responsibilities include:

- ♦ Complying with the Health and Safety Plan.
- ♦ Taking all reasonable precautions to prevent injury to themselves and to their fellow employees.

- ♦ Performing only those tasks that they believe they can do safely, and immediately reporting any accidents and/or unsafe conditions to the Site Safety Officer.
- ♦ Notifying the Project Manager and Site Safety Officer of any special medical problems (e.g. allergies) and making certain that all on-site personnel are aware of any such problems.

3.0 SITE DESCRIPTION AND HISTORY

The following material is taken from Versar Inc.'s Health and Safety Plan, Lockwood Corporation, Gering, Nebraska (1/31/87).

The site is located in a rural area southeast of Gering, Nebraska. The site is bordered on the north by State Highway 92 and on the south by an unlined ditch that flows into the Gering Drain. The North Platte River is located about 1.5 miles northeast of the site and it is believed groundwater flows toward the river.

Lockwood Corporation manufactures dump truck body hoists, pumps, hydraulic cylinders, truck bodies, center pivot irrigation systems, potato harvesters, and potato planters. Manufacturing processes at the facility include machine forging, welding, galvanizing, fabrication, phosphatizing, painting, and assembly. Hazardous wastes are generated by the galvanizing and painting operations and in the chain plant. Spent solvents are generated from small parts washers located throughout the facility. Nonhazardous wastewater is generated from the phosphatizing operation. The regulated units include a closed surface impoundment (cells I and II),

several drum storage and handling areas, and an underground tank to store spent sulfuric acid, hydrochloric acid, and machine coolant fluids. Each of the waste streams are described in greater detail below.

Wastes from the Galvanizing Operation or Chain Plant

1. Caustic waste (D002) - Spent sulfuric acid - from two 5,000-gallon tanks is generated from a hot dip zinc galvanizing operation. Spent hydrochloric acid is generated when the chain plant is operating (about 3-4 months per year). the spent acid wastes are stored in a 40,000-gallon underground tank prior to transport for off-site disposal.
2. Waste acid sludge (D002) - Sludge from the dip tanks is generated when the tanks are cleaned. Each cleaning, which is done periodically, generates 150 drums of waste which are stored on-site for subsequent transport for off-site disposal.
3. Waste caustic sludge (D002) - Approximately five drums of sodium hydroxide waste sludges are generated when a caustic tank is cleaned. they are stored on-site until subsequent transport for off-site disposal.

Wastes from the Painting Operation

4. Waste MEK, xylene, and toluene solvents (F003, F005) - Spent solvents are generated as paint thinners and cleaners used in the painting area. Wastes are stored ind rums on-site until transported off-site for recycling.

5. Waste paint sludge (F003, F005, D001) - Sludges from the painting operation are stored on-site in drums. About 2,000 pounds/months are produced. They are later transported for off-site disposal in a municipal landfill.
6. Waste paint filters from the painting booths are collected in drums containing water. About 600 pounds/month are produced. They are later transported for off-site disposal in a municipal landfill.

Waste from Small Parts Washers

7. Waste petroleum naphtha and perchloroethylene (D001, F002) - Spent solvents from the small parts washers are stored in drums prior to transport off-site. About 1,700 pounds/month of spent solvent wastes are generated.

Wastes from Phosphatizing Operation

8. Phosphoric acid and other reagents are used to condition metal surfaces for painting. About 3,500 gallons/15 weeks of phosphating wastewater is produced. It is discharged to the sewer for treatment at the P01W.

Lockwood Corporation's initial notification as a TSD facility was submitted on August 13, 1980. Though removed from the Hazardous Waste Management System in 1981, Lockwood received revised notifications as a TSD facility for D001 and D002 on May 23, 1983. On January 30, 1986, Lockwood submitted a subsequent notification adding F003 and F005 wastes for TSD. From July 24, 1984, to May 28, 1986, spent pickle liquor waste K062 was also listed as a facility waste but a recent ruling causes the listing for that waste to be D002 only.

A suspected release of 5,00 gallons of neutralized spent pickle liquor through a breach in the lining of cell 2 was documented during a NDEC inspection of April 18, 1984. The facility received an Administrative Order on June 20, 1984, to immediately stop using the impoundment. A closure plan for the impoundments was submitted in July 1985 and a post-closure plan was submitted in September 1985. Ten monitoring wells were installed in October 1985. On July 9, 1986, NDEC approved the modified closures and post-closure plans. Closure of the surface impoundment has been initiated and the cap was inspected by NDEC on March 30, 1987.

Groundwater samples collected from the monitoring wells and during soil borings did indicate high levels of metals. Samples collected from a municipal well 2,000 feet from the site did not indicate concentrations of metals exceeding the Drinking Water Standards.

Spent pickle liquor from the galvanizing process was discharged to an on-site surface impoundment prior to June 20, 1984. The first impoundment, cell I, was unlined and received wastes from December 1972 until February 1978. Half of cell I was removed because the North Platte Natural resource District constructed an unlined drainage ditch south of cell I. the replacement impoundment, cell II was built immediately north of cell I and bentonite clay was disked into the upper 6 inches of soil. Cell II received wastes from February 1978 until June 1984. the impoundments are inactive and closure has been initiated. Spent pickle liquor, sludges, and other hazardous wastes are currently stored in drums or a tank until they are transported for treatment or disposal off-site (see site description).

4.0 SAMPLING/ANALYSIS PLAN

A sampling and analysis plan has been prepared for the site and is available as a separate document.

5.0 HAZARD ASSESSMENT

5.1 Hazardous Materials

A review of previous data indicate the following hazardous materials may be encountered during work activities:

Acids	Paint Pigments
Halogenated Solvents	Pickling Liquors
Metals Sludges	Caustics
Metals	Non-Halogenated Solvents

5.2 The following table (1) summarizes the highest observed concentration, PEL, DLH, symptom/effects of acute exposure, and photoionization for known site contaminants. The table was taken from Versar Inc.'s Health and Safety Plan, Lockwood Corporation, Gering, Nebraska (1/31/87) and updated where necessary.

TABLE 2
EXPOSURE LIMITS AND SELECTED PHYSICAL CHARACTERISTICS

COMPOUND	EXPOSURE STANDARD ^a	IDLH LEVEL ^b	ODOR	ODOR THRESHOLD	L.E.L. ^c	U.E.L. ^d	I.P. ^e	V.P. ^f
Benzene	1 ppm	2000 ppm	Sweet, solventy	4.6-12.0 ppm	1.4%	7.1%	9.25 eV	75 mmHg at S.T.P.
Ethylbenzene	100 ppm	2000 ppm	Aromatic	140 ppm	1.0%	6.7%	8.76 eV	7.1 mmHg at S.T.P.
Gasoline	300 ppm	2000 ppm	Gasoline	0.25 ppm	1.4%	7.6%	---	---
Toluene	200 ppm	2000 ppm	Rubbery, mothballs	0.11 ppm	1.27%	7.1%	8.82 eV	2 mmHg at S.T.P.
Xylene	100 ppm	10,000 ppm	Sweet	0.5 ppm	1.0%/ 1.1%/ 1.1%	6.0%/ 7.0%/ 7.0%	8.56 eV/ 8.56 eV/ 8.44 eV	7 mmHg/9 mmHg/ 9 mmHg

(a) OSHA PEL

(b) Immediately Dangerous to Life and Health

(c) Lower Explosive Limit

(d) Upper Explosive Limit

(e) Ionization Potential

(f) Vapor Pressure

TABLE 3

SYMPTOMS OF EXPOSURE, FIRST AID TREATMENT
AND TARGET ORGANS

COMPOUND	ROUTES OF ENTRY	SYMPTOMS OF EXPOSURE	GENERAL FIRST AID TREATMENT	TARGET ORGANS
Benzene	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, nose, respiratory system; giddiness, headache, nausea; staggered gait; fatigue; anorexia, lassitude; dermatitis; bone marrow, depressant/depression; abdominal pain; (carginogenic/ carcinogen)	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Artificial respiration Swallow: Medical attention immediately	Blood, central nervous system, skin, bone marrow, eyes, respiratory system.
Ethylbenzene	Inhalation, skin and/or eye contact	Irritation eyes, mucous membrane; headache; dermatitis; narcosis, coma	Eye: Irrigate immediately Skin: Water flush promptly Breath: Artificial respiration Swallow: Medical attention immediately	Eyes, upper respiratory system, skin, central nervous system
Toluene	Inhalation, skin absorption, ingestion, skin and/or eye contact	Fatigue; weakness; confusion, euphoria, dizziness; headache; dilated pupil, lacrimation; nervousness; muscle fatigue; insomnia; paresthesia; dermatitis; photophobia	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Artificial respiration Swallow: Medical attention immediately	Central nervous system, liver, kidneys, skin
Xylene	Inhalation, skin absorption, ingestion, skin and/or eye contact	dizziness, excitement, drowsiness, uncoordination, staggering, gait; irritation eyes, nose, throat; corneal vacuolization; anorexia; nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Artificial respiration Swallow: Medical attention immediately	Central nervous system, eyes, gastrointestinal tract, blood, liver, kidneys, skin
Gasoline	Inhalation, skin absorption, ingestion, skin and/or eye contact	Eye irritant, irritation of the mucous membranes, depression of central nervous system, dizziness, headache, uncoordination; if inhaled in high concentrations, anesthesia, coma, and respiratory arrest.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Artificial respiration Swallow: Medical attention immediately	---

TABLE 3 (Continued)

COMPOUND	ROUTES OF ENTRY	SYMPTOMS OF EXPOSURE	GENERAL FIRST AIR TREATMENT	TARGET ORGANS
<u>General First Aid Treatment</u>				
EYE				
Irrigate immediately -		If this chemical comes in contact with the eyes, immediately wash the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately.		
SKIN				
Soap wash promptly -		If this chemical comes in contact with the skin, promptly wash the contaminated skin with soap and water. If this chemical penetrates through the clothing, promptly remove the clothing and wash the skin with soap and water and seek medical attention promptly.		
Water flush promptly -		If this chemical comes in contact with the skin, flush the contaminated skin with water promptly. If this chemical penetrates the clothing, immediately remove the clothing and flush the skin with water promptly. If irritation persists after washing, seek medical attention.		
BREATH				
Artificial respiration-		If a person breathes in large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.		
SWALLOW				
Medical attention - immediately		If this chemical has been swallowed, get medical attention immediately.		

TABLE 1
Known Site Contaminant Summary

Known Site Contaminants	Highest Observed Concentrations (Specify units and media)	PEL ppm or mg/m ³ (Specify)	IDLH ppm or mg/m ³ (Specify)	Symptom/Effects of Acute Exposure	Photoionization Potential
Sulfuric Acid	pH: 0.1	PEL: 1 mg/m ³	80 mg/m ³	Eye, nose, and throat irritation, pulmonary edema, skin and eye burns.	NA
Hydrogen Chloride	pH: 0.1	PEL: 5 ppm	100 ppm	Eye, nose, and throat irritation, pulmonary edema, skin and eye burns.	12.74 eV
Sodium Hydroxide	pH: 12.6	PEL: 2 mg/m ³	250 mg/m ³	Nose irritation, pneumontis skin and eye burns.	9 eV
Methykethylketone	NA	PEL: 200 ppm	3,000 ppm	Eye and nose irritation, dizziness, vomiting.	9.48 eV
Xylene (D)	NA	PEL: 100 ppm	1,000 ppm	Dizziness, excitment, drowsiness, eye, nose, and throat irritation.	8.56 eV
Toluene (D)	NA	PEL: 100 ppm	2,000 ppm	Fatigue, muscular weakness, dizziness, insomnia, dilated pupils.	8.82 eV
Perchloroethylene	NA	PEL: 25 ppm	500 ppm	Eye, nose and throat irritation, nausea, flushed face, dizziness, incoherence, headache.	9.32 eV
Petroleum Naptha	NA	PEL: 400 ppm	10,000 ppm	Light headedness, weakness, nausea, giddiness, eye and nose irritation.	10.17 eV (for hexane, a similar compound)

NA = Not Available

NE = None Established

U = Unknown

S = Soil

SW = Surface Water

T = Tailings

F = Flyash

TK = Tanks

A = Air

GW = Ground water

SL = Sludge

D = Drums

L = Lagoon

TABLE 1 (Continued)

Known Site Contaminants	Highest Observed Concentrations (Specify units and media)	PEL ppm or mg/m ³ (Specify)	IDLH ppm or mg/m ³ (Specify)	Symptom/Effects of Acute Exposure	Photoionization Potential
Phosphoric Acid (TK)	NA	PEL: 1 mg/m ³	NA	Eye, skin, and upper respiratory tract irritation, eye and skin burns.	12.6
Zinc	9.6% TK 3.4% SL 0.01 ppm GW 1200 mg/L S	NA	NA	NA	NA
Lead	675 mg/kg TK 1.8% SL 0.1 mg/L GW 1.1 mg/L S	PEL: 0.05 mg/m ³	NA	Lassitude, insomnia, pulmonary edema	NA
Arsenic	5.4 mg/kg SL 0.02 GW 0.055 mg/L S	PEL: 10 ug/m ³	NA	Ulceration of nasal septum, dermatitis, Gastrointestinal disturbance.	NA
Cadmium	11 mg/kg SL 0.002 ppm GW 0.04 mg/L S	PEL: 0.2 mg/m ³	40 mg/m ³	Pulmonary edema, chills, pain, tight chest.	NA
Chromium	13 mg/kg TK 3.2% SL 0.14 mg/L GW 0.1 mg/L S	PEL: 0.1 mg/m ³	30 mg/m ³	Respiratory, nasal septum irritation, inflammation of mucous membrane of eye lids, eye injury, sensitization, dermatitis.	NA

NA = Not Available

NE = None Established

U = Unknown

S = Soil
A = AirSW = Surface Water
GW = Ground waterT = Tailings
SL = SludgeF = Flyash
D = DrumsTK = Tanks
L = Lagoon

6.0 OTHER HAZARDS

6.1 Explosion and Fire - There are many potential causes of explosions and fires:

- ♦ Chemical reactions that produce explosion, fire, or heat
- ♦ Ignition of explosive or flammable chemicals
- ♦ Ignition of materials due to oxygen enrichment
- ♦ Agitation of shock- or friction-sensitive compounds
- ♦ Sudden release of materials under pressure

6.1.1 Explosions and fires may arise spontaneously. Explosions and fires not only pose the obvious hazards of intense heat, open flame, smoke inhalation, and flying objects, but may also cause the release of toxic chemicals into the environment. Explosive atmospheres and flammable vapors will be monitored to help protect against these hazards. All potential ignition sources will be kept away from an explosive or flammable environment and non-sparking, explosion-proof equipment will be utilized. Safe practices will also be followed when performing any task that might result in the agitation or release of chemicals.

6.2 Safety Hazards - The site may contain numerous safety hazards such as:

- ♦ Holes or ditches
- ♦ Precariously positioned objects
- ♦ Sharp objects such as nails, metal shards, and broken glass
- ♦ Slippery surfaces

- ♦ Uneven terrain
- ♦ Unstable surfaces

6.2.1 Some safety hazards are a function of the work itself. For example, heavy equipment creates an additional hazard for workers in the vicinity of the operating equipment. Protective equipment can impair a worker's agility, hearing, communication, and vision resulting in an increased risk of an accident. Accidents involving physical hazards can directly injure workers and can create additional hazards: increased chemical exposure due to damaged protective equipment, for example, or danger of explosion caused by the mixing of chemicals. Site personnel should constantly look out for potential safety hazards, and should immediately inform the Site Safety Officer of any new hazards so that mitigative action can be taken.

6.3. Electrical Hazards - Overhead power lines, downed electrical wires, and buried cables all pose a danger of shock or electrocution if workers contact or sever them during site operations. Electrical equipment used on-site may also pose a hazard to workers. To help minimize this hazard, low-voltage equipment with ground-fault interrupters and water-tight, corrosion-resistant connecting cables should be used on-site. In addition, lightning is a hazard during outdoor operations, particularly for workers handling metal equipment. To eliminate this hazard, weather conditions will be monitored; in case of an electrical storm, work will be suspended.

6.4 **Heat Stress** - Heat stress is a major hazard, especially for workers wearing protective clothing. The same protective materials that shield the body from chemical exposure also limit the dissipation of body heat and moisture. Depending on the ambient conditions and the work being performed, heat stress can occur very rapidly - within as little as 15 minutes. In its early stages, heat stress can cause rashes, cramps, discomfort and drowsiness, resulting in impaired functional ability that threatens the safety of both the individual and co-workers. Continued heat stress can lead to heat stroke and death.

6.4.1 Signs and symptoms of heat stress:

- ♦ Heat Rash - May result from continuous exposure to heat and humid air and aggravated by chafing clothes. FIRST AID: Rest in a cool dry place. Apply soothing lotions or powder.
- ♦ Heat Cramps - Caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
 - muscle spasms
 - pain in the hands, feet, and abdomen

FIRST AID: Massage the affected muscles. Drinking Gatorade during the day and using some salt on foods usually prevents this condition.

- ◆ Heat Exhaustion - Occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- pale, cool, moist skin
- heavy sweating
- dizziness
- nausea
- fainting
- shallow breathing

FIRST AID: Rest in a cool place. Drink cool (not hot or ice cold) fluids. A physician should be called, especially if vomiting or loss of consciousness occurs.

- ◆ Heat Stroke - The most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body to prevent serious injury or death. Competent medical help must be obtained. Signs and symptoms are:

- red, hot, usually dry skin
- lack of or reduced perspiration
- nausea
- dizziness and confusion
- strong, rapid pulse
- coma

FIRST AID: Hospitalization is required without delay, but do not wait for the ambulance to arrive before starting first aid. Move the victim to a cool place, soak the victim's clothing in cool water, and fan the body to encourage cooling.

6.4.2 Heat stress will be monitored by measuring the heart rate for 30 seconds at the beginning of each rest break. The heart rate should not exceed 110 beats per minute; if it does, the next work period will be shortened by one-third.

6.5 Cold Stress - Persons working outdoors in temperatures at or below freezing may be frostbitten. Extreme cold for a short time may cause severe injury to exposed body surfaces, or result in profound generalized cooling, causing death. Areas of the body which have a high surface area-to-volume ratio such as fingers, toes, and ears, are the most susceptible.

Two factors influence the development of a cold weather injury: ambient temperature and wind velocity. 'Wind chill' is an index used to describe the chilling effect of moving air in combination with low temperatures. For instance, a temperature of 10 degrees Fahrenheit, accompanied by a wind of 15 miles per hour (mph), is equivalent in chilling effect to still air at -18 degrees Fahrenheit.

As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, if chemical-protective equipment is removed, exposing perspiration-soaked clothing, the body will cool rapidly.

'Frostbite' is a generic term describing any local injury resulting from cold. There are several degrees of damage. Frostbite of the extremities can be categorized as follows:

- ♦ Frost nip or incipient frostbite: characterized by sudden blanching or whitening of skin.
- ♦ Superficial frostbite: skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- ♦ Deep frostbite: tissues are cold, pale, and solid; extremely serious injury.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. It can be fatal. Its symptoms are usually exhibited in five stages: 1) shivering, 2) apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95 degrees Fahrenheit, 3) unconsciousness, glassy stare, slow pulse, and slow respiratory rate, 4) freezing of the extremities, and finally, 5) death.

In addition, the Tyvek protective clothing worn at this site presents special concerns with regard to cold stress. Because the disposable protective clothing specified for this project is not air permeable and, therefore, does not breath, perspiration cannot evaporate. During strenuous physical activity, workers' clothes

can become wet. These wet clothes combined with cold temperatures can lead to hypothermia. If the air temperature is less than 40 degrees Fahrenheit and a worker becomes wet, the worker must change to dry clothes.

6.6 Noise - Due to the equipment used during this work effort, excessive noise levels may be encountered.

6.6.1 If excessive noise levels occur, personnel will be issued hearing protection which must be worn. (See Table 4 for permissible noise exposures.)

6.7 This is an active site and workers should take precautions to avoid interfering with normal daily operations.

TABLE 2

PERMISSIBLE NOISE EXPOSURES¹

Duration per day, hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

¹ When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: $C_1/T_1 + C_2/T_2 \dots C_n/T_n$ exceeds unity, then the mixed exposure should be considered to exceed the limit value. C_n indicates the total time of exposure at a specified noise level, and T_n indicates the total time of exposure permitted at that level.

Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

From 29 CFR 1910.95, Occupational Noise Exposure (7-1-88 edition).

7.0 SUMMARY OF PROJECT RISKS FOR PROJECT PERSONNEL

- 7.1 Project personnel may be exposed to low concentrations of the materials listed in Section 5.0, primarily via skin contact or inhalation of airborne contaminants.
- 7.2 Project personnel may be exposed to other hazards as listed in Section 6.0.
- 7.3 To prevent hazards related to these potential exposures, logical and reasonable precautions will be implemented to provide a suitable level of protection.

8.0 TRAINING

- 8.1 Project personnel and on-site project management/supervisors will have had 40-hour hazardous waste worker health and safety training per ~~29~~ 29 CFR 1910.120. On-site project management and supervisors will also have had at least eight additional hours of specialized supervisory training on managing hazardous waste operations.
- 8.2 Project personnel will not engage in field activities unless they have been trained to a level commensurate with their job function and responsibilities and with the degree of anticipated hazards.
- 8.3 Several of the personnel working on-site shall be fully trained in first aid and CPR.

8.4 All personnel will attend a health and safety meeting, both prior to initiating any site activity, and also before and after each work day. The purposes of these safety meetings, given by the Site Safety Officer, are to:

- ♦ Describe the assigned tasks and their potential hazards
- ♦ Coordinate activities
- ♦ Identify methods and precautions to prevent injuries
- ♦ Plan for emergencies
- ♦ Describe any changes in the Site Safety Plan (i.e. to include changing environmental conditions, environmental monitoring data, etc.)
- ♦ Explain use, care, and limitations of personnel protective clothing and equipment
- ♦ Provide medical surveillance
- ♦ Describe the characteristics and potential hazards of potentially present contamination
- ♦ Identify site work zone designations
- ♦ Explain environmental monitoring
- ♦ Describe decontamination procedures
- ♦ Receive worker feedback on conditions affecting safety and health
- ♦ Receive worker feedback on how well the Site Health and Safety Plan is working

9.0 PERSONAL PROTECTIVE EQUIPMENT

Personnel entering a hazardous waste site must be protected against potential hazards. The purpose of personal protective clothing and equipment (PPE) is to shield or isolate individuals from the chemical, physical, and biologic hazards that may be encountered at a hazardous waste site. Careful selection and use of adequate PPE should protect the respiratory system, skin, eyes, face, hands, feet, head, body, and hearing.

No single combination of protective equipment and clothing is capable of protecting against all hazards. This PPE should be used in conjunction with other protective methods.

9.1 The overall levels of protection required for work activities are Level D or Level C. The type of equipment or protective ensembles required for each level of protection are as follows:

- ♦ Level D1: Coveralls with long sleeves
Boots, steel toe and shank
Hard hat
Safety glasses
Gloves (outer) - nitrile (if contact with potentially contaminated soil or water is expected)
- ♦ Level D2: One-piece Saranex laminated Tyvek coverall
Boots, chemical resistant, steel-toe and shank
Overboot, chemical resistant, disposable (optional)
Hard hat (face shield is optional)
Safety glasses and/or splash goggles
Gloves (inner) - vinyl
Gloves (outer) - nitrile

- ♦ Level C1: One-piece Saranex laminated Tyvek coverall
Boots, chemical resistant, steel toe and shank
Overboot, chemical resistant, disposable
Hard hat
Safety glasses and/or splash goggles
Gloves (inner) - vinyl
Gloves (outer) - nitrile
Half-face, air-purifying respirator, organic
vapor/acid gas/HEPA/dusts/fumes/mists cartridges,
MSHA/NIOSH approved
- ♦ Level C2: One-piece Saranex laminated Tyvek coverall
Boots, chemical resistant, steel toe and shank
Overboot, chemical resistant, disposable
Hard hat
Gloves (inner) - vinyl
Gloves (outer) - nitrile
Full-face, air-purifying respirator, organic
vapor/acid gas/HEPA/dusts/fumes/mists cartridges,
MSHA/NIOSH approved

9.2 The decision whether to wear Level D or Level C PPE will be based on the results of environmental monitoring (Section 12).

- ♦ Level D1 PPE will be worn when air monitoring readings do not exceed background concentrations, and personnel will not come into contact with potentially contaminated materials.
- ♦ Level D2 PPE will be worn when PID readings do not exceed background concentrations, but personnel will come into contact with potentially contaminated material, e.g., discolored soil.

- ◆ Level C1 PPE with half-face respirators will be worn when PID readings are between 0 and 10 ppm above background concentrations on a continuous basis.
- ◆ Level C2 PPE with full-face respirators will be worn when breathing zone concentrations are between 10 and 50 ppm above background concentrations on a continuous basis.
- ◆ Concentrations greater than 50 ppm above background concentrations will require the use of Level B PPE or the stoppage of work until PID measurements decline to less than 50 ppm.

Level B PPE shall consist of:

- ◆ Saranex laminated Tyvek coverall
- ◆ Boots, chemical resistant, steel toe and shank
- ◆ Overboot, chemical resistant, disposable
- ◆ Hard hat
- ◆ Gloves (inner) - vinyl
- ◆ Gloves (outer) - nitrile
- ◆ Positive pressure-demand

Self-contained breathing apparatus or positive pressure-demand airline respirator, MSHA/NIOSH approved

9.3 The type of equipment used and the overall level of protection will be reevaluated periodically as the amount of information about the site increases, and as workers are required to perform different tasks. Personnel will be able to upgrade or downgrade their level of protection with concurrence of the Site Safety Officer and approval of the Project Manager.

Reasons to upgrade:

- ♦ Known or suspected presence of dermal hazards
- ♦ Occurrences or likely occurrence of gas or vapor emission
- ♦ Change in work task that will increase contact or potential contact with hazardous materials
- ♦ Request of the individual performing the task

Reasons to downgrade:

- ♦ New information indicating that the situation is less hazardous than was originally thought
- ♦ Change in site conditions that decreases the hazard
- ♦ Change in work task that will reduce contact with hazardous materials

9.4 Prior to field work, all field personnel shall be qualitatively fit tested with the respirator to be used during field work via isoamyl acetate or irritant smoke. In addition, all personnel shall perform a positive/negative pressure test in the field prior to entering the exclusion zone. No field personnel will be allowed to work in a respirator for which they have not been fit-tested, or if they have failed a qualitative fit test. Protocols for these tests are outlined in Appendix B. Fit test results are to be recorded on the proper form by the Site Safety Officer.

9.5 During equipment use, personnel will report any perceived problems or difficulties to the Site Safety Officer. These malfunctions include, but are not limited to:

- ♦ Degradation of the protective ensemble
- ♦ Perception of odors

- ♦ Skin irritation
- ♦ Unusual residues on PPE
- ♦ Discomfort
- ♦ Resistance to breathing
- ♦ Fatigue due to respirator use
- ♦ Interferences with vision or communication
- ♦ Restriction of movement
- ♦ Personal responses such as rapid pulse, nausea, and chest pain

9.6 Storage

- 9.6.1 Clothing and respirators will be stored properly to prevent damage or malfunction due to exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures, and impact.

9.7 PPE Inspection Checklists

9.7.1 Clothing

Before use:

- ♦ Visually inspect for:
 - imperfect seams
 - non-uniform coatings
 - tears
 - malfunctioning closures
- ♦ Hold up to light and check for pinholes.
- ♦ Flex product:
 - observe for cracks
 - observe for other signs of shelf deterioration

At break times and periodically during use, check for:

- ♦ Evidence of chemical attack:
 - discoloration
 - swelling
 - stiffness(Important: Also bear in mind that chemical permeation can occur without any visible effects.)
- ♦ Physical Damage
 - Closure failures
 - Tears
 - Punctures
 - Seam discontinuities

9.7.2 Gloves

- ♦ Before use, pressurize glove to check for pinholes. Either blow into glove and roll gauntlet towards fingers, or inflate glove and hold under water. In either case, no air should escape.

9.7.3 Respirators

Air-Purifying Respirators

- ♦ Inspect air-purifying respirators:
 - before each use to be sure they have been adequately cleaned
 - after each use
 - during cleaning
 - monthly if in storage for emergency use
- ♦ Check material conditions for:
 - signs of pliability
 - signs of deterioration
 - signs of distortion

- ♦ Examine cartridges to ensure that:
 - they are the proper type for the intended use
 - the expiration date has not been passed
 - they have not been opened or used previously
- ♦ Check faceshields and lenses for:
 - cracks
 - crazing
 - fogginess

9.8 Additional Safety Equipment will be available on-site and shall include:

- ♦ Industrial First Aid Kit, No. 25
- ♦ ABC fire extinguisher
- ♦ Hearing protection
- ♦ Cool drinking water
- ♦ Emergency eyewash, 1 liter minimum
- ♦ An escape self-contained breathing apparatus of at least five minutes duration

10.0 MEDICAL SURVEILLANCE

10.1 All personnel involved in daily work activities will have had a pre-task medical examination within the past year, including:

- ♦ Physical examination
- ♦ Pulmonary function testing
- ♦ Blood chemistry
- ♦ Urine chemistry
- ♦ Chest x-ray
- ♦ Review of employee occupational and medical history

- 10.2 The purpose of the physical examination is to (a) obtain background blood and urine chemistries, (b) note conditions that could increase susceptibility to heat stroke, and (c) determine the ability of personnel to wear respirators.
- 10.3 Employees who are clearly unable to perform based on medical history and physical examination (e.g. those with lung, heart, or kidney functional impairments) will be prohibited from working in contaminated areas.
- 10.4 Wearing of contact lenses while in contaminated atmospheres which require the use of a respirator shall not be allowed.
- 10.5 Additional medical examinations will be performed whenever the following have occurred: (a) actual or suspected excessive exposure to contaminants, (b) injury or temperature stress, or (c) experience of exposure symptoms.
- 10.6 Medical examinations will be performed by an occupational physician designated or approved by HWST.

11.0 SAFE WORK PRACTICES

- 11.1 To maintain a strong safety awareness and to enforce safe procedures at the work site, the following practices must be followed:
- ♦ Smoking, eating, drinking, chewing gum/tobacco, and applying of cosmetics are prohibited during field work which includes potential exposure to hazardous substances.

- ♦ Possession of matches, lighters, and other spark-producing devices during field work involving potential exposure to hazardous substances is prohibited.
- ♦ All required respiratory devices and protective clothing must be worn by all personnel during field work. Facial hair and long hair interfere with respirator fit and wearer vision. Facial hair or cosmetics which interfere with a satisfactory respiratory-to-face seal are not permitted. Long hair must be effectively contained within protective hair coverings.
- ♦ Medicine and alcohol can increase the effects of some chemical and physical agents. Prescribed drugs should not be taken by field personnel unless specifically approved by an HWST occupational physician. Alcoholic beverages or unauthorized drug consumption is strictly forbidden during work operations.
- ♦ Changes in work practices or work rules shall be implemented only after approval by the Project Manager and the designated Site Safety Officer.
- ♦ Unnecessary contact with contaminated surfaces or waste materials is to be avoided.
- ♦ Eyeglasses with conventional temple pieces (earpiece bars) will interfere with the respirator-to-face seal of a full faceplate. A spectacle kit should be installed in the face masks of workers requiring vision correction.
- ♦ Personnel should thoroughly wash their hands and face before eating, drinking, or smoking following field activities.
- ♦ All personnel should be familiar with standard safety procedures and instructions contained in the Site Health and Safety Plan.

- ◆ No one may work alone in the field, i.e., out of earshot or visual contact of other workers.
- ◆ All personnel have the obligation to report or correct unsafe work conditions.
- ◆ All electrical magnetic, hydraulic, manual, and any other equipment that might produce a static discharge shall be properly bonded and/or grounded to prevent static build up.
- ◆ Horseplay is forbidden. Use of good judgment and common sense is requisite.

11.2 Drilling Safety

- 11.2.1 Only personnel designated or authorized to operate or climb on the drill rig will do so. Other personnel will not operate or climb on the drill rig under any circumstances.
- 11.2.2 All drill rig operators shall pay deliberate attention to watching for workers on the ground who may be in their path and provide warning to these people before moving.
- 11.2.3 Drill rigs are not to be operated within 10 feet plus 0.4 inch for each 1kv over 50kv, of lines rated at greater than 50kv.
- 11.2.4 Before drilling near electrical lines, the owner of the line or the owner's authorized representatives must be notified and provided with all pertinent information.

- 11.2.5 Any overhead wire must be considered energized until the owner of the line or the owner's authorized representative states that it is de-energized.
- 11.2.6 All other utilities must be identified as described in Section 15.0.
- 11.2.7 All loose equipment should be secured before the drill rig truck is put into motion.
- 11.2.8 While the mast is being raised or lowered, no one shall occupy the cab of the truck. All persons except the operator at the controls shall stay clear of the area.
- 11.2.9 Except when moving very short distances, the drill mast should be lowered. If the mast is not lowered, the site shall be surveyed to determine the presence of overhead obstructions which the mast could contact.
- 11.2.10 It is essential to keep the body, particularly arms, hands, and feet, from under or above any piece of drilling apparatus that could drop or rise suddenly.
- 11.2.11 Clothing should be tight fitting, as loose clothing could be caught in equipment or machinery.
- 11.2.12 The work site shall be kept clear of obstructions. Small tools and shovels shall remain on the drill when not in use.

- 11.2.13 Mud shall not be allowed to accumulate in the working area. It can cause slippery conditions and unsafe footing.
- 11.2.14 Cleaning of auger flights shall not be done while the auger is rotating.
- 11.2.15 If the auger is operating in reverse, workers shall stay clear of the upper flight edge.
- 11.2.16 Daily inspections prior to using equipment shall be made. The inspections should include a thorough check of the hydraulic hoses, connections, and valves. Deficiencies shall be corrected or safe conditions verified before starting the equipment.
- 11.2.17 Unattended drill holes shall be adequately covered or protected to avoid the possibility of animals or people accidentally falling into them.
- 11.2.18 For additional drill operation safety instructions, refer to HWS Technologies Inc. "Safety Instructions".

12.0 ENVIRONMENTAL MONITORING

- 12.1 A total volatile organics instrument shall be used to periodically monitor airborne concentrations of contaminants on the site. An HNU HW-101 Photoionization Detector (PID) will be used to screen areas for volatile organic compound contamination. The PID will also be used to measure employee breathing zone levels of organic vapors and gases.

The air monitoring program will include sufficient monitoring of air quality in work zones and other on-site areas to assess levels of employee exposure, determine that the work zone designations are valid, and verify that the respiratory protection being worn by personnel is adequate. Monitoring for flammable/combustible gases and/or oxygen levels shall also be conducted. To accomplish this, a combustible gas indicator/oxygen meter shall be utilized.

12.1.1 Prior to work, background instrumentation measurements will be established and recorded with all support equipment engines turned off to eliminate the interfering effects of exhaust. All field measurements of this nature will be obtained and documented on the appropriate forms (Appendix A) by the Site Safety Officer. In addition, all values generated are subject to immediate interpretation as a means of ensuring the effectiveness of the existing level of protection.

12.1.2 Measurements shall be taken at the anticipated source and in the breathing zone of site personnel (see Table 5).

12.1.3 Heavily contaminated soil layers most likely to be encountered in areas of known chemical/solvent spills or leaks may demonstrate the potential to vent when physically disturbed by drilling/sampling equipment. This venting process may result in elevated airborne contaminant concentrations of health and safety significance both at the source and in worker breathing zones.

In addressing this potential, the use of remote sampling probes, physical proximity of personnel relative to the source, and upgrading the level of protection will be considered.

12.1.4 Instruments shall only be used by employees who have been trained in the proper operation, use, limitations, and calibration of the monitoring instrument and who have demonstrated the skills necessary to operate the instrument.

12.1.5 Environmental monitoring may be increased, reduced, or modified by the Site Safety Officer, with concurrence of the Project Manager, based on site conditions and monitoring results.

12.2 Worker protection and general worker guidelines have been established based upon the toxicity of contaminants found or expected to be present on the site. The Occupational Safety and Health Administration (OSHA) has established Permissible Expressive Limits (PELs) for air contaminants within the workplace. The PELs are established legal standards that must not be exceeded.

TABLE 3
ENVIRONMENTAL MONITORING

The following monitoring instruments shall be utilized on-site. Measurements shall be documented on the appropriate forms (Appendix A). All instrumentation will be calibrated before use and documented.

<u>Instrument</u>	<u>Work Tasks</u>	<u>Frequency and Location</u>
HNU	All site work	At the perimeter* of the site at least twice daily or whenever conditions change
	Soil boring	In the breathing zone continuously
	Monitoring Well Sampling	At the perimeter of the Exclusion Zone at least once in the breathing zone initially
	Decontamination equipment	At the perimeter of the decontamination pad area
Combustible Gas Indicator/Oxygen Analyzer ¹	Soil boring	Periodically in borehole

¹ Action Levels:

- Less than 10% LEL - continue operations, monitor every 15 minutes
- 10-20% LEL - continue operations, monitor continuously with extreme caution as higher levels are encountered
- Greater than 20% LEL- shut down operations, evaluate source

* Monitoring shall be conducted at locations upwind and downwind at the perimeter of the site.

An employee's exposure to any material on a TWA basis over an 8-hour shift will not exceed the PEL concentrations (see Table 1).

All sampling and analysis will be performed in compliance with NIOSH methods as presented in the NIOSH Manual of Analytical Methods, Third Edition.

13.0 SITE CONTROL

13.1 To reduce the accidental spread of hazardous substances by workers from the contaminated area to the clean area, zones will be delineated on the sites where different types of operations will occur, and the flow of personnel among the zones will be controlled. The establishment of work zones will help ensure that personnel are properly protected against the hazards present where they are working, that work activities and contamination are confined to the appropriate areas, and that personnel can be located and evacuated in an emergency.

Within these zones, prescribed operations will occur utilizing appropriate personal protective equipment. Movement between areas will be controlled at checkpoints. The zones are as follows:

- ♦ Exclusion Zone
- ♦ Contamination Reduction Zone
- ♦ Support Zone

Exclusion Zone ("Hot Zone"): The Exclusion Zone is the innermost area of the three and is where contamination does or could occur.

All personnel entering the Exclusion Zone must wear the prescribed level of protection. An entry checkpoint will be established at the periphery of the Exclusion Zone to control the flow of personnel and equipment between contiguous zones and to ascertain that the procedures established to enter and exit the zones are followed.

Level CI PPE shall be required of all personnel within the Exclusion Zone during soil boring operations. Level D2 protection shall be required during groundwater sampling, based on the potential for contact with contaminated water. Work zones need not be established, however, direct reading monitoring shall be performed to determine the adequacy of the PPE. Monitoring with direct reading instruments will be performed to determine the adequacy of the PPE and the need to upgrade or downgrade. The Exclusion Zone corresponding to each boring will extend to include all areas within a 25-foot radius of the boring. Subsequent to initial operations, the boundary may be readjusted based on observations and/or measurements. Personnel working in the Exclusion Zone may include the Project Manager, the work parties, and specialized personnel such as drill rig operators.

Contamination Reduction Zone: The Contamination Reduction Zone is the transition area between the contaminated area and the clean area. This zone is designed to reduce the probability that the clean Support Zone will become contaminated or affected by other site hazards. The distance between the Exclusion and Support Zones provided by the Contamination Reduction Zone, together with decontamination of workers and equipment, limits the physical transfer of hazardous substances into clean areas. This zone is where decontamination of personnel and equipment takes place. Access into and out of the Contamination Reduction Zone from the Exclusion Zone, and to the Contamination Reduction Zone from the

Support Zone, are through access control points. Personnel entering at this station will be wearing the prescribed personal protective equipment for working in the Exclusion Zone.

Support Zone: The Support Zone is the outermost part of the site and is considered non-contaminated or "clean". The Support Zone is the location of the administrative and other support functions (e.g., equipment). Any function that need not or cannot be performed in a hazardous or potentially hazardous area is performed here. Any contaminated or potentially contaminated personnel, clothing, equipment, and samples must remain in the Contamination Reduction Zone until decontaminated. The Support Zone shall be established near the entrance to the site.

13.2 Non-essential access to both the Exclusion and Contamination Reduction Zones will be strictly controlled. Only personnel who are essential to the completion of the task will be allowed access to these areas, and only if they are wearing the prescribed level of protection.

13.3 Once designated, the Exclusion Zone will be conspicuously identified through the use of traffic cones, flags, ropes, or other suitable means.

13.4 Drilling/sampling should be performed in such a manner so as to prevent, or reduce, as much as possible, any splashing or other contamination of the employee or his/her personal protection equipment.

13.5 Decontamination of personnel and equipment will be performed as described in Section 14.0 before entering the Support Zone from the Contamination or Reduction Zone.

13.6 Each piece of equipment will be inspected for proper and safe operation prior to its use.

13.7 The Buddy System

13.7.1 Most activities in contaminated or otherwise hazardous areas should be conducted with a buddy who is able to:

- ♦ Provide his or her partner with assistance
- ♦ Observe his or her partners for signs of chemical or heat exposure
- ♦ Periodically check the integrity of his or her partner's protective clothing
- ♦ Notify the Site Safety Officer or others if emergency help is needed

14.0 DECONTAMINATION

Decontamination protects workers from hazardous substances that may contaminate and eventually permeate the protective clothing, respiratory equipment, tools, vehicles, and other equipment used on-site; it protects all site personnel by minimizing the transfer of harmful materials into clean areas; it helps prevent mixing of incompatible chemicals; and it protects the community by preventing uncontrolled transportation of contaminants from the site. No worker, except under emergency situations, will leave the Exclusion Zone without going through the proper decontamination sequences.

14.1 Personnel

The degree of decontamination required is a function of the particular task as well as the physical environment within which it takes place. The following decontamination procedure, although somewhat specific to the tasks described therein, will remain flexible to allow decontamination to respond appropriately to the changing environmental and sampling conditions which may arise at the sampling site.

- 14.1.1 Upon leaving the "hot zone" for lunch or at the end of the day, personnel will be required to remove all contaminated protective clothing/equipment.
- 14.1.2 Upon completion of field activities, the work crew will walk towards the Contamination Reduction Zone.
- 14.1.3 Equipment, i.e., shovels, tools, etc., will remain in the Exclusion Zone. Boot covers and outer gloves will be washed with a soap and water solution, rinsed with fresh water, and removed within the Exclusion Zone.
- 14.1.4 The workers will then enter the Contamination Reduction Zone. Personal protection equipment will be washed with a soap and water solution and rinsed with fresh water. Respirator cartridges and other personal protective equipment can be replaced or removed in the zone.
- 14.1.5 Following removal of all personal protective equipment, workers will enter the Support Zone.

14.1.6 Contaminated personal protective equipment i.e., suits and gloves, respirator cartridges, etc., will be considered contaminated and placed in sealed 6-mil plastic bags labeled "Hazardous Waste" and prepared for proper disposal. Cleaned reusable personal protective equipment will be dried and placed into 6-mil plastic bags for storage.

14.1.7 Spent solutions and wash water will be placed into containers and prepared for proper disposal.

14.1.8 Decontamination of personnel utilizing Level D and C personal protective equipment will follow the generalized procedures outlined in Figure 14.1 and 14.1.6, respectively.

14.1.9 Decontamination equipment and supplies consist of the following:

- ♦ Potable water
- ♦ Washtubs
- ♦ Detergent
- ♦ Brushes
- ♦ Plastic sheeting
- ♦ 5-gallon buckets with lids
- ♦ Garbage bags

14.2 Emergency Decontamination

14.2.1 In an emergency, the primary concern is to prevent the loss of life or severe injury to site personnel. If immediate medical treatment is required to save a life, decontamination should be delayed until the victim is

stabilized. If decontamination can be performed without interfering with essential life-saving techniques or first aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe injury or loss of life, decontamination must be performed immediately. If an emergency due to a heat-related illness develops, protective clothing should be removed from the victim as soon as possible to reduce the heat stress.

- 14.2.2 See Figure 14.2 for a decision aid for emergency decontamination.

14.3 Decontamination of Tools

- 14.3.1 ~~When all work activities have been completed, tools will be totally decontaminated.~~ Tools will be decontaminated between each sample collection point or grid.
- 14.3.2 It is expected that all tools will be constructed of non-porous, non-absorbent materials. This will aid in the decontamination process. Any tool or part of a tool which is made of a porous/absorbent material may be discarded if it cannot be properly decontaminated.
- 14.3.3 Tools will be placed on a decontamination pad or into a bucket and thoroughly washed with a high pressure, high temperature "hotsy-type" sprayer prior to being removed from the site. All visible particles are to be removed before the tool is considered clean.

- 14.3.4 Those tools which would be damaged by high pressure spray will be cleaned manually, using a soap solution and mechanical brushing, followed by a fresh water rinse.

14.4 Decontamination of Environmental Monitoring Equipment/Instruments

- 14.4.1 Once contaminated, instruments are difficult to clean without damaging them. Any delicate instrument which cannot be easily decontaminated should be protected while it is being used. It should be placed in a clear plastic bag, and the bag taped and secured around the instrument. Openings are made in the bag for sample intake.

14.5 Heavy Equipment Decontamination

- 14.5.1 When all drilling/sampling activities have been completed, the heavy equipment will be decontaminated.
- 14.5.2 Partial decontamination efforts will be conducted in the Exclusion Zone to the contamination reduction zone. As much mud, dirt, rock, etc. as possible will be mechanically removed from the tires, tracks, or outside of the equipment. Washing or rinsing of the equipment will not take place in the Exclusion Zone.
- 14.5.3 The heavy equipment will then be driven from the Exclusion Zone to the contamination reduction zone and decontaminated using a high pressure, high temperature "hotsy-type" device.

15.0 UTILITIES

15.1 Before drilling activities begin, all utilities, i.e., electricity, natural gas lines, etc., should be identified and deactivated. In addition, natural gas lines should be purged to remove all potentially explosive gases.

15.2 The deactivation of utilities should be certified by the proper utility company personnel, and the certification retained in the permanent log.

16.0 CHECK-IN/CHECK-OUT PROCEDURES

All personnel working on-site shall sign a check-in sheet when arriving each morning and shall sign out each evening when leaving the site (Appendix A). Visitors will require clearances by the site safety officer and project manager, visitors will only be allowed in the support zone area unless compliance with the health and safety plan is met.

17.0 FIRST AID AND EMERGENCY PROCEDURES

17.1 Drilling and sampling activities at this site lend themselves to a wide variety of injuries which could require first aid or emergency treatment. Because of these hazards, the following items will be located on site at all times.

- ♦ Industrial First Aid kit, No. 25
- ♦ First aid manual
- ♦ Portable eye wash
- ♦ Blankets

- ♦ Emergency phone number list
- ♦ Emergency route map to health center (Figure 17.1)
- ♦ An escape self-contained breathing apparatus of at least five minutes duration

17.2 Some personnel working on-site shall be fully trained in first aid and CPR.

17.3 Should any situation of unplanned occurrence require outside or support services, the appropriate contacts should be made. The list of appropriate contacts is listed in Section 19.0 of the Health and Safety Plan. In the event that an emergency develops on-site, the procedures delineated herein are to be immediately followed. The Site Safety Officer or Project Manager shall be notified of any on-site emergencies and be responsible for ensuring that the appropriate procedures are followed. Emergency conditions are considered to exist if:

- ♦ any member of the field crew is involved in an accident, or experiences any adverse effects or symptoms of exposure while on-site; or
- ♦ a condition is discovered that suggests the existence of a situation more hazardous than anticipated.

The following emergency procedures should be followed:

17.3.1 Personnel on-site should use the "buddy system" (pairs). Buddies should pre-arrange hand signals or other means of emergency signals for communication. Some examples of useful hand signals follow:

- ♦ Hand gripping throat: out of air, cannot breathe.
- ♦ Grip partners wrist or place both hands around waist: leave area immediately, no debate.
- ♦ Hands on top of head: need assistance.
- ♦ Thumbs up: okay, I'm all right, I understand.
- ♦ Thumbs down: no, negative.

- 17.3.2 Entrance and exit routes for the work area should be planned and emergency escape routes delineated by the on-site Safety Officer.
- 17.3.3 Visual contact should be maintained between "pairs" on-site, with the team remaining in close proximity in order to assist each other in case of emergencies.
- 17.3.4 In the event that any member of the field crew experiences any adverse effects or symptoms of exposure while on-site, the entire field crew should immediately halt work and act according to the instructions provided by the on-site Safety Officer.
- 17.3.5 Wind indicators visible to all on-site personnel should be provided by the Project Manager to indicate possible routes for upwind escape.
- 17.3.6 Any indication that the situation is more hazardous than anticipated should result in the evacuation of the field team and re-evaluation of the hazard and the level of protection required.

17.3.7 In the event that an accident occurs, the Project Manager is to complete an Accident Report Form for submittal to the Safety Coordinator, who will forward a copy to the Human Resources Manager. The Safety Coordinator should assure that the follow-up action is taken to correct the situation that caused the accident. ALL injuries must be reported to the Site Safety Officer or Project Manager.

17.4 Personnel Injury in the Exclusion Zone: Upon notification of an injury in the Exclusion Zone, all site personnel shall assemble at the decontamination line. The rescue team will enter the Exclusion Zone (if required) to remove the injured person to the hotline. The Site Safety Officer and Project Manager should evaluate the nature of the injury, and the affected person should be decontaminated to the extent possible prior to movement to the Support Zone. The appropriate first aid shall be initiated, and contact should be made for an ambulance and with the designated medical facility (if required). No persons shall reenter the Exclusion Zone until the cause of the injury or symptoms is determined.

17.5 Personnel Injury in the Support Zone: Upon notification of an injury in the Support Zone, the Project Manager and Site Safety Officer will assess the nature of the injury. If the cause of the injury or loss of the injured person does not affect the performance of site personnel, operations may continue, with initiation of the appropriate first aid and necessary follow-up as stated above. If the injury increases the risk to others, all site

personnel shall move to the decontamination line for further instructions. Activities on-site will stop until the added risk is removed or minimized.

17.6 Back and Neck Injuries: Site personnel with suspected back or neck injuries are not to be removed until professional emergency assistance arrives.

17.7 Fire/Explosion: Upon notification of a fire or explosion on site, all site personnel will assemble at the decontamination line. The fire department shall be alerted and all personnel moved to a safe distance from the involved area.

17.8 Personal Protective Equipment Failure: If any site worker experiences a failure or alteration of protective equipment that affects the protection factor, that person and his/her buddy shall immediately leave the Exclusion Zone. Reentry shall not be permitted until the equipment has been repaired or replaced.

17.9 Other Equipment Failure: If any other equipment on-site fails to operate properly, the Project Manager and Site Safety Officer shall be notified to determine the effect of this failure on continuing operations on site. If the failure affects the safety of personnel or prevents completion of the Work Plan tasks, all personnel shall leave the Exclusion Zone until the situation is evaluated and appropriate actions taken.

17.10 In all situations, when an on-site emergency results in evacuation of the Exclusion Zone, personnel shall not reenter until:

1. The conditions resulting in the emergency have been corrected.
2. The hazards have been reassessed.
3. The Site Safety Plan has been reviewed.
4. Site personnel have been briefed on any changes in the Site Safety Plan.

18.0 FIRE PREVENTION AND PROTECTION

To protect against fires, the following special precautions must be taken:

- ♦ Before drilling commences the Site Safety Officer must be contacted. A detailed inspection of the work area will be conducted to determine if potential fire sources exist. The fire sources must be removed at least 35 feet away before work can commence.
- ♦ Two full ABC fire extinguishers must be located at the work area when drilling is being conducted.

19.0 EMERGENCY INFORMATION

19.1 If an emergency develops on-site, the procedures as listed in Section 17.0 should be utilized. Should the situation require outside support services, the client will be notified along with the appropriate contact from the list which follows.

19.2 West Nebraska General Hospital (308) 635-3711
 4021 Avenue B
 Scottsbluff, Nebraska

Route to Hospital from Site:

Take Highway 92 west into Gering, becomes M Street. turn right (north) on 10th Street (Highway 71) and continue across the bridge over the North Platte river. turn left (west) onto the Scottsbluff-Gering Beltline (first light beyond bridge) and continue about 0.1 mile then turn right (north) on Avenue B. Continue on Avenue B through Scottsbluff. Hospital is north of the town on Avenue B, refer to Figure 17.1 for location of West Nebraska General Hospital.

Poison Control Center	(308) 632-2333
CHEMTREC	(800) 424-9300
State Police	(308) 632-1211
Police	911
Fire	911
Client Contacts	(308) (308)
HWST Project Manager - Sean Brown	(402) 479-2200
HWST Safety Coordinator - Ron Sorensen	(402) 479-2200
Client Safety Officer	(402)
HWS Technologies Inc. (Lincoln)	(402) 479-2200
(Denver)	(303) 771-6868

19.3 The following information should be provided:

- ♦ Name
- ♦ Location
- ♦ Telephone number
- ♦ Nature of problem
- ♦ What response is needed

20.0 DOCUMENTATION

20.1 The Site Safety Officer will document implementation of this Health and Safety Plan. The HWST safety coordinator will set up a file to retain health and safety related records and activity reports. The file will include the following:

- ♦ Signed copies of the Health and Safety Plan Acceptance Form
- ♦ Exposure History Form
- ♦ Accident Report Form
- ♦ Records of safety violations and remedial actions taken
- ♦ Daily Instrument Calibration Check Sheet
- ♦ Air Monitoring Form
- ♦ Daily Personnel Sign-In/Sign-Out Sheet

The Accident Report Forms shall be filled out by the Project Manager in the event of an accident.

A health and safety field logbook will be maintained on-site and should include information such as: level of personal protection worn, environmental monitoring instrumentation readings, weather conditions, employees on-site, subjects discussed during site health and safety meetings, and safety violations.

APPENDIX A

HEALTH AND SAFETY PLAN ACCEPTANCE FORM

Instructions: This form is to be completed by each person to work on the subject project work site and returned to the Project Manager and Safety Coordinator.

Project Name _____

Project Number _____

Date _____

I represent that I have read and understand the contents of the above plan and agree to perform my work in accordance with it.

Name (Print)

Signature

Date

Company/Division

EXPOSURE HISTORY FORM

Project Name: _____

Project Number: _____

Location: _____

Dates From/To: _____

ON-SITE HWST PERSONNEL

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

EXPOSURE HISTORY FORM (continued)

SUSPECTED CONTAMINANTS

VERIFIED CONTAMINANTS

AIRBORNE CONCENTRATION

HWS TECHNOLOGIES INC.
ACCIDENT REPORT FORM

To _____

From _____

Project Name _____ Project Number _____

Date of Accident _____ Time of Accident _____

Reported by _____

Exact Location of Accident _____

Name of Injured or Ill Employee _____

Names of Witnesses _____

Description of Accident _____

Nature of Illness or Injury and Part of Body Involved _____

Corrective Action Taken _____

Corrective Action Remaining to be Taken (By Whom and By When) _____

What Can be Done to Prevent a Recurrence of this Type of Accident?

Signature of Supervisor/Manager _____

Date _____

NOTE: Do Not Use For Motor Vehicle Accidents

DAILY INSTRUMENT CALIBRATION CHECK SHEET

Project Name _____ Instrument _____

Project Number _____ Serial # _____

Date	Pure Air Y/N	Calibration Gas (ppm)	Battery Check (Good/Bad)	Calibrated by	Notes
------	-----------------	--------------------------	-----------------------------	------------------	-------

AIR MONITORING

DESCRIPTION

Name(s) _____

Date: _____

Project Name _____

Project Number _____

Estimated Wind Direction _____

Estimated Wind Speed (i.e., calm, moderate, strong, etc.) _____

Weather Conditions _____

Comments (use reverse side of this form if necessary)

Time	Location	Instrument Type and Reading %, ppm, other	Type of Survey BZ=Breathing Zone GA=General Area, Perimeter C=Contact (1"-2" from source)	Activity in Progress	
				Yes	No

DAILY PERSONNEL SIGN-IN/SIGN-OUT SHEET

Project Name: _____

Project Number _____ Date: _____

Site Conditions: _____

[illegible]

APPENDIX B

APPENDIX D to § 1910.1025—QUALITATIVE FIT TEST PROTOCOLS

This appendix specifies the only allowable qualitative fit test protocols permissible for compliance with paragraph (D)(3)(ii).

1. ISOAMYL ACETATE PROTOCOL

A. Odor threshold screening.

1. Three 1-liter glass jars with metal lids (e.g. Mason or Ball jars) are required.

2. Odor-free water (e.g. distilled or spring water) at approximately 25°C shall be used for the solutions.

3. The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 cc of pure IAA to 800 cc of odor free water in a 1-liter jar and shaking for 30 seconds. This solution shall be prepared new at least weekly.

4. The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well ventilated but may not be connected to the same recirculating ventilation system.

5. The odor test solution is prepared in a second jar by placing .4 cc of the stock solution into 500 cc of odor free water using a clean dropper or pipette. Shake for 30 seconds and allow to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution may be used for only one day.

6. A test blank is prepared in a third jar by adding 500 cc of odor free water.

7. The odor test and test blank jars shall be labelled 1 and 2 for jar identification. If the labels are put on the lids they can be periodically dried off and switched to avoid people thinking the same jar always has the IAA.

8. The following instructions shall be typed on a card and placed on the table in front of the two test jars (i.e. 1 and 2):

"The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

9. The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

10. If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA QITP may not be used.

11. If the test subject correctly identifies the jar containing the odor test solution he may proceed to respirator selection and fit testing.

B. Respirator selection.

1. The test subject shall be allowed to select the most comfortable respirator from a large array of various sizes and manufacturers that includes at least three sizes of elastomeric half facepieces and units of at least two manufacturers.

2. The selection process shall be conducted in a room separate from the fit-test chamber to prevent odor fatigue. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to assess an "comfortable" respirator. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This may not constitute his formal training on respirator use, only a review.

3. The test subject should understand that he is being asked to select the respirator which provides the most comfortable fit for him. Each respirator represents a different size and shape and, if fit properly, will provide adequate protection.

4. The test subject holds each facepiece up to his face and eliminates those which are obviously not giving a comfortable fit. Normally, selection will begin with a half-mask and if a fit cannot be found here, the subject will be asked to go to the full facepiece respirators. (A small percentage of users will not be able to wear any half-mask.)

5. The more comfortable facepieces are recorded; the most comfortable mask is donned and worn at least five minutes to assess comfort. Assistance in assessing comfort can be given by discussing the points in #6 below. If the test subject is not familiar with using a particular respirator, he shall be directed to don the mask several times and to adjust the straps each time, so that he becomes adept at setting proper tension on the straps.

6. Assessment of comfort shall include reviewing the following points with the test subject:

- Chin properly placed.
- Positioning of mask on nose.
- Strap tension.
- Fit across nose bridge.
- Room for safety glasses.
- Distance from nose to chin.
- Room to talk.
- Tendency to slip.
- Cheeks filled out.
- Self-observation in mirror.
- Adequate time for assessment.

7. The test subject shall conduct the conventional negative and positive-pressure checks (e.g. see ANSI Z88.2-1980). Before conducting the negative- or positive-pressure checks, the subject shall be told "seat" his mask by rapidly moving the head side-to-side and up and down, taking a few deep breaths.

8. The test subject is now ready for testing.

9. After passing the fit test, the test subject shall be questioned again regarding the comfort of the respirator. If it has become uncomfortable, another model of respirator shall be tried.

10. The employee shall be given the opportunity to select a different facepiece and be retested if during the first two weeks on-the-job wear the chosen facepiece becomes unacceptably uncomfortable.

C. Fit test.

1. The fit test chamber shall be substantially similar to a clear 55 gallon drum suspended inverted over a 2-foot diameter frame, so that the top of chamber is about 18 inches above the test subject's head. The inside top center of the chamber shall have a small hook attached.

2. Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors. The cartridges or mask shall be changed at least weekly.

3. After selecting, donning, and properly adjusting a respirator himself, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well ventilated as by an exhaust fan or lab hood, to prevent general room contamination.

4. A copy of the following test exercises and rainbow (or equally effective) passage shall be taped to the inside of the test chamber:

Test Exercises

- I. Normal breathing.
- II. Deep breathing. Be certain breaths are deep and regular.
- III. Turning head from side-to-side. Be certain movement is complete. Alert the test subject not to bump the respirator on the shoulders. Have the test subject inhale when his head is at either side.
- IV. Nodding head up-and-down. Be certain motions are complete and made about every second. Alert the test subject not to bump the respirator on the chest. Have the test subject inhale when his head is in the fully up position.
- V. Talking. Talk aloud and slowly for several minutes. The following paragraph called the Rainbow Passage. Reading it will result in a wide range of facial movement and thus be useful to satisfy this requirement.

ment. Alternative passages which serve the same purpose may also be used.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

vi. Normal breathing.

5. Each test subject shall wear his respirator for at least 10 minutes before starting the fit test.

6. Upon entering the test chamber, the test subject shall be given a 6 inch by 6 inch piece of paper towel or other porous absorbent single ply material, folded in half and wetted with three-quarters of one cc of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber.

7. Allow two minutes for the IAA test concentration to be reached before starting the fit test exercises. This would be an appropriate time to talk with the test subject, to explain the fit test, the importance of his cooperation, the purpose for the head exercises, or to demonstrate some of the exercises.

8. Each exercise described in No. 4 above shall be performed for at least one minute.

9. If at any time during the test, the subject detects the banana-like odor of IAA, he shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

10. Upon returning to the selection room, the subject shall remove the respirator, repeat the odor sensitivity test, select and put on another respirator, return to the test chamber, etc. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait about 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

11. If a person cannot be fitted with the selection of half-mask respirators, include full facepiece models in the selection process. When a respirator is found that passes the test, its efficiency shall be demonstrated for the subject by having him break the face seal and take a breath before exiting the chamber.

12. When the test subject leaves the chamber he shall remove the saturated towel, returning it to the test conductor. To keep the area from becoming contaminated, the used towels shall be kept in a self-sealing bag. There is no significant IAA concen-

tration buildup in the test chamber from subsequent tests.

13. Persons who have successfully passed this fit test may be assigned the use of the tested respirator in atmospheres with up to 10 times the PEL of airborne lead. In other words this IAA protocol may be used to assign a protection factor no higher than 10.

II. SACCHARIN SOLUTION AEROSOL Protocol

A. Taste threshold screening.

1. Threshold screening as well as fit testing employees shall use an enclosure about the head and shoulders that is approximately 12 inches in diameter by 14 inches tall with at least the front portion clear and that allows free movement of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly of part # FT 14 and FT 15 combined is adequate.

2. The test enclosure shall have a three-quarter inch hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

3. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

4. The test subject shall don the test enclosure. For the threshold screening test, he shall breath through his open mouth with tongue extended.

5. Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

6. The threshold check solution consists of 0.83 grams of sodium saccharin, USP in water. It can be prepared by putting 1 cc of the test solution (see C6 below) in 100 cc of water.

7. To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely then released and allowed to fully expand.

8. Ten squeezes are repeated rapidly and then the test subject is asked whether the saccharin can be tasted.

9. If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted.

10. If the second response is negative ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted.

11. The test conductor will take note of the number of squeezes required to elicit a taste response.

12. If the saccharin is not tasted after 30 squeezes (Step 9), the test subject may not perform the saccharin fit test.

13. If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

14. Correct use of the nebulizer means that approximately 1 cc of liquid is used at a time in the nebulizer body.

15. The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least each morning and afternoon or at least every four hours.

B. Respirator selection.

Respirators shall be selected as described in section III above, except that each respirator shall be equipped with a particulate filter cartridge.

C. Fit test.

1. The fit test uses the same enclosure described in III and III2 above.

2. Each test subject shall wear his respirator for at least 10 minutes before starting the fit test.

3. The test subject shall don the enclosure while wearing the respirator selected in section A above. This respirator shall be properly adjusted and equipped with a particulate filter cartridge.

4. The test subject may not eat, drink (except plain water), or chew gum for 15 minutes before the test.

5. A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

6. The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 cc of warm water.

7. As before, the test subject shall breathe through the open mouth with tongue extended.

8. The nebulizer is inserted into the hole in the front of the enclosure and the fit test solution is sprayed into the enclosure and the fit test solution is sprayed into the enclosure using the same technique as for the taste threshold screening and the same number of squeezes required to elicit a taste response in the screening. (See B 10 above).

9. After generation of the aerosol the test subject shall be instructed to perform the following exercises for one minute each.

i. Normal breathing.

ii. Deep breathing. Be certain breaths are deep and regular.

iii. Turning head from side-to-side. Be certain movement is complete. Alert the test subject not to bump the respirator on the shoulders. Have the test subject inhale when his head is at either side.

iv. Nodding head up-and-down. Be certain motions are complete. Alert the test subject not to bump the respirator on the chest. Have the test subject inhale when his head is in the fully up position.

v. Talking. Talk aloud and slowly for several minutes. The following paragraph is

called the Rainbow Passage. Reading it will result in a wide range of facial movements, and thus be useful to satisfy this requirement. Alternative passages which serve the same purpose may also be used.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

10. Every 30 seconds, the aerosol concentration shall be replenished using one-half the number of squeezes as initially (C8).

11. The test subject shall so indicate to the test conductor if at any time during the fit test the taste of saccharin is detected.

12. If the saccharin is detected the fit is deemed unsatisfactory and a different respirator shall be tried.

13. Successful completion of the test protocol shall allow the use of the tested respirator in contaminated atmospheres up to 10 times the PEL. In other words this protocol may be used assign protection factors no higher than ten.

III. IRRITANT FUME PROTOCOL.

A. Respirator selection.

Respirators shall be selected as described in section IB above, except that each respirator shall be equipped with high efficiency cartridges.

B. Fit test.

1. The test subject shall be allowed to smell a weak concentration of the irritant smoke to familiarize him with the characteristic odor of each.

2. The test subject shall properly don the respirator selected as above, and wear it for at least 10 minutes before starting the fit test.

3. The test conductor shall review this protocol with the test subject before testing.

4. The test subject shall perform the conventional positive pressure and negative pressure fit checks. Failure of either check shall be cause to select an alternate respirator.

5. Break both ends of a ventilation smoke tube containing stannic oxychloride, such as the MSA part No. 5645, or equivalent. Attach a short length of tubing to one end of the smoke tube. Attach the other end of the smoke tube to a low pressure air pump set to deliver 200 milliliters per minute.

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6. Advise the test subject that the smoke can be irritating to the eyes and instruct him to keep his eyes closed while the test is performed.

7. The test conductor shall direct the stream of irritant smoke from the tube towards the faceseal area of the test subject. He shall begin at least 12 inches from the facepiece and gradually move to within one inch, moving around the whole perimeter of the mask.

8. The following exercises shall be performed while the respirator seal is being challenged by the smoke. Each shall be performed for one minute.

- i. Normal breathing.
- ii. Deep breathing. Be certain breaths are deep and regular.
- iii. Turning head from side-to-side. Be certain movement is complete. Alert the test subject not to bump the respirator on the shoulders. Have test subject inhale when his head is at either side.
- iv. Nodding head up-and-down. Be certain motions are complete. Alert the test subject not to bump the respirator on the chest. Have the test subject inhale when his head is in the fully up position.
- v. Talking—slowly and distinctly, count backwards from 100.

vi. Normal breathing.

9. If the irritant smoke produces an involuntary reaction (cough) by the test subject, the test conductor shall stop the test. In this case the tested respirator is rejected and another respirator shall be selected.

10. Each test subject passing the smoke test without evidence of a response shall be given a sensitivity check of the smoke from the same tube to determine whether he reacts to the smoke. Failure to evoke a response shall void the fit test.

11. Steps B4, B7, B8 of this protocol shall be performed in a location with exhaust ventilation sufficient to prevent general contamination of the testing area by the irritant smoke.

12. Respirators successfully tested by the protocol may be used in contaminated atmospheres up to ten times the PEL. In other words this protocol may be used to assign protection factors not exceeding ten.

(Approved by the Office of Management and Budget under control number 1218-0092)

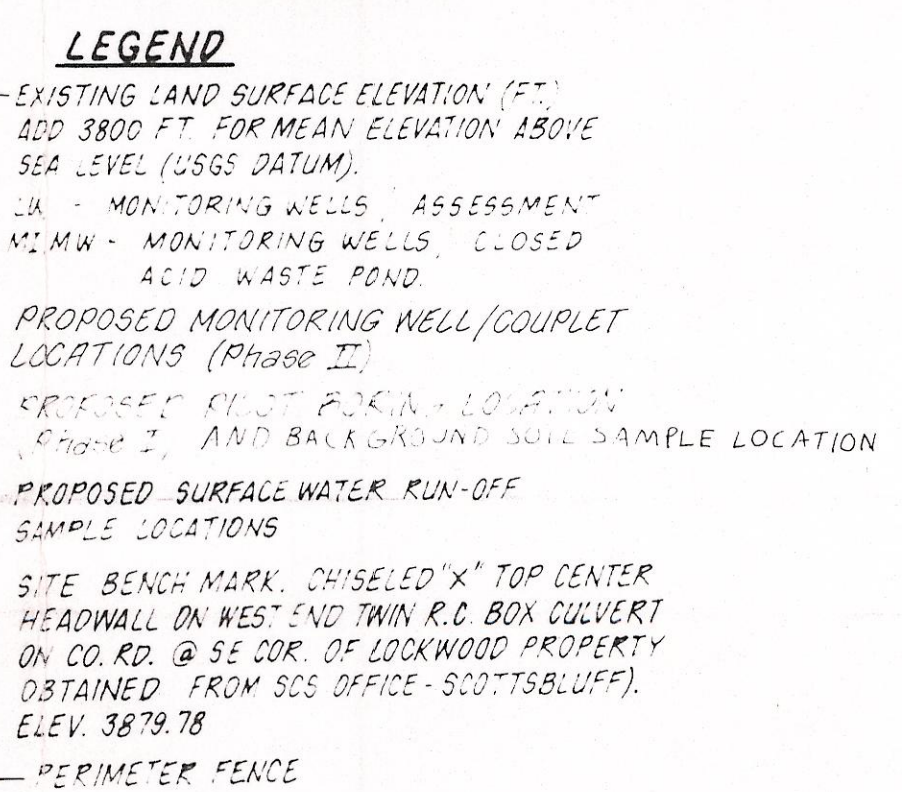
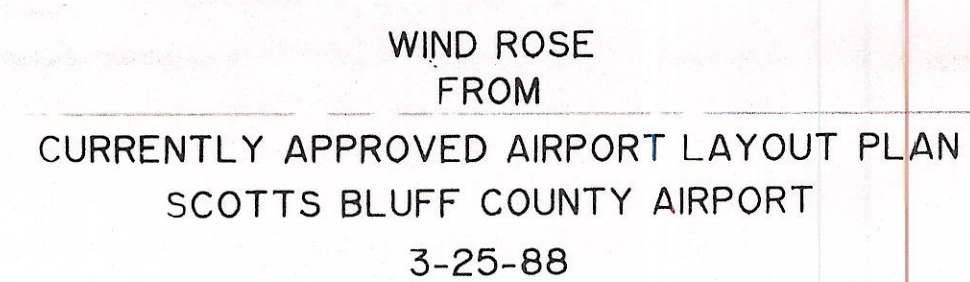
43 FR 53007, Nov. 14, 1978, as amended at 44 FR 5447, Jan. 26, 1979; 44 FR 14554, Mar. 13, 1979; 45 FR 50338, Aug. 28, 1979; 44 FR 60081, Oct. 23, 1979; 44 FR 68828, Nov. 30, 1979; 45 FR 35283, May 23, 1980; 46 FR 60775, Dec. 11, 1981; 47 FR 51117, Nov. 12, 1982; 48 FR 9641, Mar. 6, 1983; 49 FR 18295, Apr. 30, 1984)

EDITORIAL NOTE: At 49 FR 23175, June 5, 1984, the administrative stay of § 1910.1025(e)(3)(H)(B) and (E), partially

stayed at 47 FR 54433, Dec. 3, 1982, was vacated, effective June 1, 1984. For compliance provisions, see 49 FR 23175, June 5, 1984.

Negative Pressure Test. The wearer can perform this test by himself in the field. It consists merely of closing off the inlet of the canister, cartridge(s), or filter(s) by covering with the palm(s) or replacing the seal(s), or squeezing the breathing tube so that it does not pass air; inhaling gently so that the facepiece collapses slightly; and holding the breath for 10 seconds. If the facepiece remains slightly collapsed and no inward leakage is detected, the respirator is probably tight enough. This test, of course, can be used only on respirators with tight-fitting facepieces.

Positive Pressure Test. This test is similar to the negative pressure test. It is conducted by closing off the exhalation valve and exhaling gently into the facepiece. The fit is considered satisfactory if slight positive pressure can build up inside the facepiece without any evidence of outward leakage.



SOURCE: M.C. SCHAFF & ASSOCIATES, 1989
HOSKINS-WESTERN-SONDEREGGER, 1984
LOCKWOOD CORP., 1989

SHEET 1
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Revised 6-89